ANNUAL REPORT, 1979 - DIVISION OF FISHERIES REHABILITATION, ENHANCEMENT, AND DEVELOPMENT (FRED)

by

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TABLE OF CONTENTS

Section	Page
1979 FRED PRODUCTION REPORT	8
Adult salmon returns	8
Hatchery releases	9
Hatchery production summaries	9
Egg takes	10
TECHNOLOGY AND DEVELOPMENT	32
Fish culture	32
Biology	33
Limnology	35
Pathology	35
Genetics	36
Engineering	36
FRED reports	37
HATCHERIES, FISH PASSES, AND HABITAT ALTERATION	41
State hatcheries	41
Fish passes	41
Habitat alteration	41
HATCHERY BROOD STOCK DEVELOPMENT AND SALMON EGG NEEDS	46
Brood stock development	46
Central region	46
Southeastern region	49
FISHERIES AND THE UTILIZATION OF HATCHERIES	54
Background on fisheries	54
Applications of public hatcheries	54
The full potential of hatcheries	55
HISTORY AND ORGANIZATION OF FRED	66
Private non-profit hatcheries	67
Organization	69
Plans and assumptions	70
Personnel capabilities	71
PROGRAM BENEFITS	76
Analysis of benefits and costs	78
BUDGET	81
FY 80 operational budget	81
Funding and production	81
ACKNOWLEDGMENTS	86

LIST OF TABLES

Table		Page
1.	Preliminary count of salmon produced at FRED facilities that returned as adults to the fisheries and facilities in 1979	10
2.	Expected adult salmon returns to FRED facilities and projects in 1980	12
3.	1979 releases of salmon produced at FRED hatcheries	13
4.	1979 rainbow trout stocking program	15
5.	Summary of production of king salmon from Central region FRED Division facilities	16
6.	Summary of production of king salmon from Southeast region FRED Division facilities	17
7.	Summary of production of coho salmon from Central region FRED Division facilities	18
8.	Summary of production of coho salmon from Southeast region FRED Division facilities	19
9.	Summary of production of sockeye salmon from Central region FRED Division facilities	20
10.	Summary of production of pink salmon from Central region FRED Division facilities	22
11.	Summary of production of pink salmon from Southeast region FRED Division facilities	23
12.	Summary of production of chum salmon from Central region FRED Division facilities	24
13.	Summary of production of chum salmon from Southeast region FRED Division facilities	25
14.	Summary of production of steelhead trout from Southeast region FRED Division facilities	26
15.	1979 egg take summary	27
16.	FRED egg-take objectives for 1980	29
17.	Salmon stocks screened genetically during 1979 by species	38
18.	List of major projects involving FRED engineers in 1979	39
19.	Status of state hatcheries	43
20.	Fish passes in Alaska	44

Table		Page
21.	Alaskan resource product values 1960-1976	62
22.	Commercial fishing intensity in sections of Alaska during 1979 as represented by the number of salmon limited entry permits issued for various fishing gear	63
23.	1979 operational PNP hatcheries	72
24.	Proposed PNP hatcheries	72
25.	FRED Division senior staff, 1979	74
26.	Estimates of commercial values for adult salmon that will be available in Alaskan waters as a direct result of eggs incubated by FRED in Fiscal Year 1981	77
27.	Projected numbers and values of adult salmon returning to FRED hatcheries at 1980 and full capacity levels of production	78
28.	Project and facility budgets for FY 80	82
29.	FRED Division operational and capital project budgets and their effect on increases in hatchery production capabilities	84

LIST OF FIGURES

Figure		Page
1.	Salmon production at state hatcheries	11
2.	Brood stock development program of a hypothetical 66-million-egg chum salmon hatchery	52
3.	Chinook salmon catches from 1960 on compared to the 30-year consecutive high mean annual harvest	57
4.	Coho salmon catches from 1960 on compared to the 30-year consecutive high mean annual harvest	58
5.	Sockeye salmon catches from 1960 on compared to the 30-year consecutive high mean annual harvest	59
6.	Pink salmon catches from 1960 on compared to the 30-year consecutive high mean annual harvest	60
7.	Chum salmon catches from 1960 on compared to the 30-year consecutive high mean annual harvest	61
8.	Opportunities for salmon rehabilitation and enhancement through the combined use of hatchery and natural environments	64
9.	FRED Division matrix organization	73
10.	FRED Division budget summaries and operational design capacity	85

1979 PRODUCTION REPORT

Hatchery manager Dan Rosenberg inspects chum salmon eggs as they arrive for incubation at the Beaver Falls Hatchery. (ADF&G photo by Mark Kissel)

Adult salmon returns

More than 688,000 salmon released from Alaska Department of Fish and Game hatcheries returned as adults during 1979. In some areas, evaluation of hatchery returns is incomplete; the total return is expected to be somewhat higher. This preliminary figure is, however, more than two-and-a-half times greater than 1978's return of 241,000 hatchery fish. Statewide preliminary returns are presented by area in Table 1. Returns reported for the Kitoi pinks are known to be underestimated because of interception by commercial fleets outside the evaluation area.

The leading producer was the Tutka Bay Lagoon Hatchery near Homer. There, a hatchery return of 369,000 pink salmon comprised an estimated 81 percent of the total pink return to the Tutka District. Ocean survivals ranged from 5 percent for fry released upon emergence from the incubators, to 8.4 percent for those reared for short periods. There were four emergency commercial openings in Tutka Lagoon during the summer. Sport fishermen in the lagoon caught an additional 2,000 pinks.

Although an expected hatchery coho return to the Homer Spit area failed to develop, coho returns were good at Seward and Whittier. At Seward, at least 7,000 hatchery cohos appeared, and half of the 6,000 cohos caught during the Seward Silver Salmon Derby were hatchery fish. An estimated 1,500 cohos returned to the Passage Canal area of Whittier.

More than 10,000 chum salmon from the Beaver Falls Hatchery in Ketchikan were counted in the fishery and at the hatchery. This is more than three times last year's chum return. This return provided important data about chum salmon migration in the Ketchikan area.

The relationships between hatchery production and adult returns since 1974 are graphed in Figure 1. This graph shows the rapid increase in adult returns of salmon following the increase in hatchery production capabilities. Returns of hatchery fish are not completely assessed here. Catches of rainbow trout, coho salmon, and grayling that were stocked in land-locked lakes and Interior streams for sport fishermen are not reported as returns.

A projection of 1980 hatchery salmon returns, based upon standard estimates of marine survival, is presented in Table 2. The projection is conservative.

Hatchery releases

During 1979, the Division of Fisheries Rehabilitation, Enhancement, and Development released more than 55 million young salmon, 12 million more than last year. Production was 32.2 million pinks, 11.4 million sockeye, 5.5 million chums, 4.8 million cohos, and 1.1 million chinooks. This does not include 3.5 million eyed sockeye salmon eggs, which were incubated at the Kitoi Hatchery and then planted into a river bed in Kodiak's Karluk Lake system, nor the nearly 900,000 eyed pink and chum salmon eggs planted above the Irish Creek fishway near Petersburg.

An outbreak of Infectious Hematopoietic Necrosis Virus (IHNV) destroyed 1979 sockeye salmon production in the Big Lake Hatchery. More than half of the 10 million sockeye juveniles there died of IHNV. The remaining fish were destroyed to prevent other stocks from being infected. IHNV is an infection common among wild stocks of salmonids. Sockeye salmon, however, are particularly vulnerable to it. The Big Lake Hatchery was disinfected and has resumed production.

Production of young salmon by facility and species is listed in Table 3. Notice that hatcheries with established brood stocks, such as Kitoi Bay and Tutka Bay, have released large numbers of salmon. New facilities, such as Hidden Falls, Klawock, Snettisham, and Cannery Creek, are in the process of developing brood stocks.

About 353,000 rainbow trout were released from the Anchorage Area Hatcheries in 1979 (Table 4). In recent years, three stocks of rainbows have been tested to determine suitability for hatchery production and stocking programs. The Swanson stock from the Kenai Peninsula has been selected as the best brood stock. The brood stock development project has been transferred from the Ship Creek (Elmendorf) facility to the Fort Richardson Hatchery, which has better water quality. When the brood stock is developed, the FRED Division will be better able to meet the needs of the Sport Fish Division's lake stocking program.

Hatchery production summaries

The success of a production hatchery is ultimately judged by the number of fish it makes available to the fishery. FRED, therefore, seeks to achieve high survivals of eggs and fry in the hatchery, and produce healthy fish that will achieve high ocean survivals as well.

Standard egg and fish survivals have been set by the FRED Division. Data in Tables 5 through 14 compare actual survivals within FRED hatcheries with the set standards. These tables provide a record of each brood stock used in FRED hatcheries and a basis for evaluating hatchery procedures.

The technology is available to achieve standard survivals of eggs and fish in hatcheries. However, the necessity of collecting and moving eggs from remote locations and of refining hatchery water supply systems contributes to lower-than-desired survivals. Despite that, it appears that survival percentages will improve as the hatcheries settle into routine operations.

Egg takes

During 1979, FRED took approximately 88 million salmon eggs for incubation. This is nearly 7 million eggs fewer than were taken during the previous year. The decrease was due primarily to budgetary constraints, although poor escapements in some areas and flooding in others prevented FRED crews from reaching their goals. 1979 egg takes are listed in Table 15. A comparison of egg takes over the past five years is included in Figure 1.

In addition to salmon eggs, FRED took 1.6 million rainbow trout eggs, 32,000 steelhead eggs, and 519,000 grayling eggs.

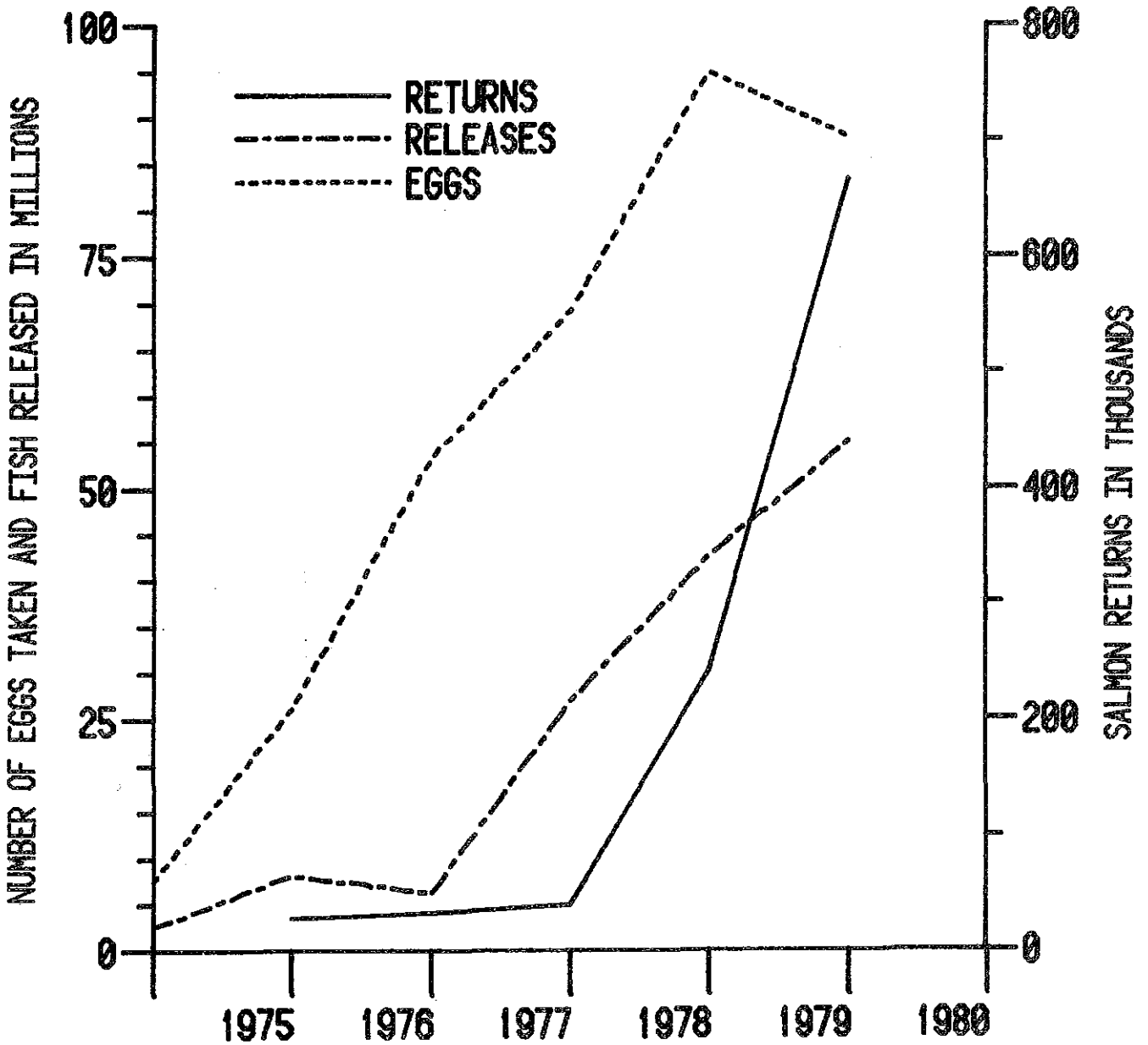
The number of eggs incubated at each facility will increase as brood stocks are developed and natural stocks rehabilitated. Egg takes planned for 1980 are listed in Table 16. The planned total of 205 million eggs assumes that brood stocks are available in expected numbers.

TABLE 1

PRELIMINARY COUNT OF SALMON PRODUCED AT FRED FACILITIES THAT RETURNED AS ADULTS TO THE FISHERIES AND FACILITIES IN 1979.

LOCATION	KINGS	COHOS	SOCKEYE	PINKS	CHUMS
Beaver Falls	---	---	---	---	10,368
Big Lake	---	---	---	---	---
Crystal Lake	1,300	38,500	---	---	---
Deer Mountain	100	200	---	---	---
Fish Creek	2	112	---	---	---
Fritz Creek	---	1	---	---	---
Halibut Cove	600	---	350	---	---
Kasilof	900	---	100	---	---
Kitoi	---	---	---	235,000	---
Leisure Lake	---	---	600	---	---
Mendenhall Ponds	---	54	---	---	---
Packers Lake	---	---	1,000	---	---
Seward	---	7,088	---	---	---
Ship Creek	124	100	---	---	---
Starrigavan Creek	109	1,000	---	20,000	---
Tustumena Lake	---	---	Unassessed	---	---
Tutka	---	---	---	369,000	---
Whittier	---	1,500	---	---	---
TOTALS	3,135	48,555	2,050	624,000	10,368
GRAND TOTAL	688,108				

FIGURE 1



SALMON PRODUCTION AT STATE HATCHERIES
(1979 Figures are Preliminary)

TABLE 2

EXPECTED ADULT SALMON RETURNS TO FRED FACILITIES AND PROJECTS IN 1980. THESE DATA ARE BASED ON STANDARIZED ASSUMPTIONS OF MARINE SURVIVAL.

FACILITY OR PROJECT	KINGS	COHOS	SOCKEYES	PINKS	CHUMS
Beaver Falls	----	----	----	----	30,374
Snettisham	----	----	----	----	273
Fish Creek	1,329	----	----	----	----
Starrigavan	2,736	20,846	----	16,044	----
Crystal Lake	2,727	12,856	----	----	----
Hidden Falls	----	----	----	----	----
Deer Mountain	----	10,303	----	----	----
Little Port Walter	1,000	3,000	----	----	1,000
Klawock	----	----	----	----	----
Big Lake	14	700	15,500	----	----
Nancy Lake	----	----	700	----	----
Whittier	----	4,000	----	----	----
Tustumena Lake	----	----	6,434	----	----
Hidden Lake	----	----	21,052	----	----
Crooked Creek	2,500	----	----	----	----
Ship Creek	1,400	----	----	----	----
Fritz Creek	----	2,200	----	----	----
Homer Spit	----	1,100	----	----	----
Leisure Lake	----	----	300	----	----
Tutka Pinks	----	----	----	195,000	----
Cannery Creek	----	----	----	28,000	----
Seward	10	14,000	----	----	----
Clear Creek	----	----	----	----	50
Lake Nunavaugaluk	----	----	20,000	----	----
Kitoi Bay	----	----	----	210,000	----
Lake Rose Tead	40	----	----	----	----
Halibut Cove	600	----	----	----	----
TOTALS:	12,357	69,005	63,986	449,044	31,697
GRAND TOTAL:	626,089				

TABLE 3
1979 RELEASES OF SALMON
PRODUCED AT FRED HATCHERIES

Facility	Brood Year, Stock, Species	Total Number of Fish Released
CENTRAL REGION		
Anchorage Area Complex	1978 Crooked Creek kings	713,552
	1978 Ship Creek kings	249,120
	1978 Halibut Cove kings	37,064
	1977 Seward cohos	1,826,676
	1977 Halibut Cove cohos	48,000
	1978 Seward cohos	1,679,022
	1978 Halibut Cove cohos	197,782
Big Lake	1978 Fish Creek cohos	582,615
	1978 Meadow Creek cohos	47,442
Cannery Creek	1978 Wells River chums	21,045
	1978 Cannery Creek pinks	2,825,634
Clear AFS	1978 Delta River chums	90,500
East Creek	1978 East Creek sockeye and 1978 Lake Nunavaugaluk sockeye	2,666,818
Kasilof	1978 Tustumena Lake sockeye	8,020,503
	1978 Hidden Lake sockeye	8,256
	1978 Crooked Creek cohos	10,740
Kitoi	1978 Big Kitoi Creek pinks	17,393,220
	1978 Karluk River sockeye	190,116
	1978 Lower Thumb River sockeye	527,460
	1978 Chignik River kings	74,417
Tutka	1978 Tutka Creek pinks	9,698,922
	1978 Port Dick chums	737,408
	CENTRAL REGION TOTAL:	47,646,312

(CONTINUED)

TABLE 3
1979 RELEASES OF SALMON
PRODUCED AT FRED HATCHERIES
(CONTINUED)

Facility	Brood Year, Stock, Species	Total Number of Fish Released
SOUTHEASTERN REGION		
Beaver Falls	1978 Beaver Falls-Disappearance Creek chums	2,426,174
Crystal Lake	1978 Duncan Salt Chuck cohos	128,676
	1978 Andrews Creek kings	16,200
Deer Mountain	1977 Cripple Creek kings	18,122
	1977 Ketchikan Creek cohos	103,033
Hidden Falls	1978 Kadashan chums	1,678,212
	1978 Clear River chums	210,972
Klawock	1978 Klawock River chums	232,779
Snettisham	1977 Andrews Creek kings	11,577
	1977 Situk River kings	7,372
	1978 Prospect Creek chums	22,083
	1978 Limestone Creek chums	93,839
	1978 Speel Lake cohos	9,042*
Starrigavan	1978 Starrigavan Creek chums	3,127
	1978 Starrigavan Creek pinks	2,261,104
	1978 Starrigavan Creek pinks (fingerling)	10,812
	1977 Starrigavan Creek cohos	154,515
	1977 Little Port Walter (Sashin Creek) cohos	53,937
	SOUTHEASTERN REGION TOTAL:	7,441,576
	GRAND TOTAL:	55,087,888

* Released into First Lake as part of a lake stocking project.

TABLE 4

1979 RAINBOW TROUT STOCKING PROGRAM

Strain	Size	Number Stocked	Location Stocked
Ennis	Catchable	52,448	Anchorage Area Lakes, Mat-Su Valley Lakes, Elmendorf/Ft. Richardson Lakes, Fairbanks Area Lakes
Ennis	Sub-Catchable	101,314	
Swanson, domestic	Catchable	19,015	
Swanson, domestic	Fingerling	160,107	
Talarik	Fingerling	20,131	

Remaining on hand:

Strain	Number	Purpose
Swanson, wild	21,900	Replacement brood stock.
Swanson, domestic	59,400	Sub-catchables for spring stocking, Fairbanks.
Talarik	47,900	Catchables, 1980, Anchorage area.

TABLE 5
SUMMARY OF PRODUCTION OF KING SALMON FROM CENTRAL REGION F.R.E.D. DIVISION FACILITIES
1979

Facility	Brood Year, Brood Stock	--Number Produced/(Actual % Survivals from Previous Stage to this Stage--) Green eggs	Eyed eggs (90%)	Fry (95%)	Fingerling (90%)	Smolt (80%)	Adult Returns (3%)
			---(% Survival Goals from Previous Stage to this Stage)---				
Kitoi	1978 Chignik River	120,443	93,014 (77%)	88,339 (95%)	74,417 1/ (84%)		
Ft. Rich	1978 Ship Creek	402,800	326,556 (81%)	300,000 (92%)	249,712 (83%)	249,120 1/ (99.7%)	
	1978 Crooked Creek	894,857	850,114 (86%)	833,112 (98%)	716,476 (86%)	713,552 1/ (99.6%)	
	1978 Halibut Cove	90,478	75,162 (83%)	75,000 (99%)	37,257 (50%)	37,064 1/ (99%)	

1/ Number released

TABLE 6
SUMMARY OF PRODUCTION OF KING SALMON FROM SOUTHEAST REGION F.R.E.D. DIVISION FACILITIES
1979

Facility	Brood Year, Brood Stock	--Number Produced/(Actual % Survivals from Previous Stage to this Stage--) Green eggs	Eyed eggs (90%)	Fry (95%)	Fingerling (90%)	Smolt (80%)	Adult Returns (3%)
			---(% Survival Goals from Previous Stage to this Stage)------				
Deer Mountain	1977 Cripple Creek	90,000	26,540 (29.5%)	20,718 (78.1%)		18,157 1/ (87.6%)	
	1978 Cripple Creek	2/	115,793	112,184 (96.9%)			
Crystal Lake	1978 Andrews Creek	34,875	28,675 (82.2%)	16,236 (56.6%)		16,200 1/ (99.8%)	
Snettisham	1977 Andrews Creek	26,687	16,289 (61.0%)	13,972 (85.8%)		11,617 3/ (83.1%)	
	1977 Situk River	39,628	9,147 (23.1%)	8,719 (95.3%)		7,412 3/ (85.0%)	

1/ Number released
2/ Number unknown, transferred from Little Port Walter.
3/ Of this number 40 were sent as samples to Bob Davis, the remainder were released.

TABLE 7

SUMMARY OF PRODUCTION OF COHO SALMON FROM CENTRAL REGION F.R.E.D. DIVISION FACILITIES
1979

Facility	Brood Year, Brood Stock	--Number Produced/(Actual % Survivals from Previous Stage to this Stage)- Green eggs	Eyed eggs (90%)	Fry (95%)	Fingerling (90%)	Smolt (80%)	Adult Return (10%)
			---(% Survival Goals from Previous Stage to this Stage)---				
Kasilof	1978 Crooked Creek	23,688	14,120 (60%)	12,434 (88%)	10,740 1/ (86%)		
Big Lake	1978 Fish Creek	669,520	650,789 (92.8%)	763,518 2/ (117%)	611,900 1/ (80%)		
	1978 Meadow Creek	62,246	60,317 (96.6%)	78,720 2/ (130%)	59,400 1/ (75%)		
Ft. Rich	1977 Seward	2,406,529		2,286,203 (95%)	2,419,030 (94%)	1,826,676 1/ (85%)	
	1977 Halibut Cove Lagoon	171,978		153,061 (89%)	150,000 (98%)	48,000 1/ (32%)	
	1978 Seward	2,180,800	2,085,600 (96%)	1,981,320 (95%)	1,679,022 1/ (85%)		
	1978 Halibut Cove Lagoon	274,200	209,500 (76%)	199,025 (95%)	197,782 3/ (99%)		

1/ Number released
2/ Revised estimate. Previous count was wrong.
3/ Lost due to power outage

TABLE 8

SUMMARY OF PRODUCTION OF COHO SALMON FROM SOUTHEAST REGION F.R.E.D. DIVISION FACILITIES

1979

Facility	Brood Year, Brood Stock	--Number Produced/(Actual % Survivals from Previous Stage to this Stage--) Green eggs	Eyed eggs (90%)	Fry (95%)	Fingerling (90%)	Smolt (80%)	Adult Returns (10%)
		---(% Survival Goals from Previous Stage to this Stage)------					
Deer Mountain	1977 Ketchikan Creek	157,732	139,153 (88.2%)	114,112 (82.0%)		103,033 1/ (90.3%)	
	1978 Ketchikan Creek	63,131	61,886 (98.0%)	58,184 (94.0%)			
Klawock	1978 Klawock River	19,319	17,625 (91.2%)	15,736 (89.3%)			
Crystal Lake	1978 Duncan Salt Chuck	454,842	420,318 (92.4%)	174,035 (41.4%)		128,676 1/ 3/	
Snettisham	1978 Speel Lake	189,824	184,524 (97.2%)	184,256 (99.9%)			
Starrigavan	1977 Starrigavan Creek	479,765	235,236 (49.0%)	196,294 (83.4%)		154,515 1/ (78.7%)	
	1977 Little Port Walter (Sashin Creek)	2/	149,327	143,666 (96.2%)		53,937 1/ (37.5%)	
	1978 Starrigavan Creek	420,169	376,471 (89.6%)	356,502 4/ (94.7%)			

1/ Number released

2/ Number unknown. Eyed eggs transferred from Little Port Walter.

3/ An additional 11,438 fingerling are being held for release in 1980.

4/ On June 14 and 21 this stock was destroyed (destroyed 342,051 fish) because of lack of operating funds to keep facility open and because creek was already at peak capacity with natural stocks.

TABLE 9
SUMMARY OF PRODUCTION OF SOCKEYE SALMON FROM CENTRAL REGION F.R.E.D. DIVISION FACILITIES
1979

Facility	Brood Year, Brood Stock	--Number Produced/(Actual % Survivals from Previous Stage to this Stage)-- Green eggs	Eyed eggs (90%)	Fry (95%)	Fingerling (90%)	Smolt (80%)	Adult Return (10%)
			---(% Survival Goals from Previous Stage to this Stage)---				
Kasilof	1978 Tustumena Lake	9,364,349	8,396,973 (90.4%)	8,047,912 (96%)	8,020,503 1/ (99%)		
	1978 Hidden Lake	311,808	275,008 (88%)	24,728 (9%)	8,256 1/ (33%)		
Big Lake*	1978 Meadow Creek (Big Lake)	691,116	615,246 (89%)	428,879 (70%)			
	1978 (Meadow Creek ♀) x 1978 (Glacier Creek ♂)	9,370,228	6,894,098 (73.6%)	6,003,152 (87%)			
	1978 Moose Creek (Kenai River)	19,584	17,525 (89.5%)	4,931 (28%)			
	1978 Dave's Creek (Kenai River)	17,010	15,893 (83.4%)	10,248 (64%)			
	1978 Russian River	12,648	11,698 (92.5%)	7,312 (63%)			
	1978 Nancy Lake	573,568	566,934 (98.8%)	457,789 (81%)			
	1978 Fish Creek (Big Lake)	75,195	65,119 (86.8%)	59,242 (91%)			

* This survival refers only to the survival to emergent fry. All fry were killed after IHNV outbreak.
1/ Number released

TABLE 9
(CONTINUED)
SUMMARY OF PRODUCTION OF SOCKEYE SALMON FROM CENTRAL REGION F.R.E.D. DIVISION FACILITIES
1979

Facility	Brood Year, Brood Stock	--Number Produced/(Actual % Survivals from Previous Stage to this Stage)-- Green eggs	Eyed eggs (90%)	Fry (95%)	Fingerling (90%)	Smolt (80%)	Adult Returns (10%)
			---(% Survival Goals from Previous Stage to this Stage)---				
East Creek	1978 East Creek	251,046	240,000 (95.6%)	2,686,202 1/ (102%)	2,662,674 2/ (99.3%)		
	1978 Beach Stock (Lake Nunavaugaluk)	2,510,460	2,400,000 (95.6%)				
Kitoi	1978 Karluk River	589,549	425,579 (72%)	262,342 (61.6%)	190,116 2/ (72%)		
	1978 Lower Thumb River (Karluk)	2,638,149	2,083,535 2/ (79%)		527,460 2/ (60.7%)		
Devil's Creek	1978 Upper Thumb River (Karluk)	3,073,286	26,600,000 2/ (84.6%)				

1/ Revised estimate. Previous count was wrong.
2/ Number released

TABLE 10

SUMMARY OF PRODUCTION OF PINK SALMON FROM CENTRAL REGION F.R.E.D. DIVISION FACILITIES
1979

Facility	Brood Year, Brood Stock	--Number Produced/(Actual % Survivals from Previous Stage to this Stage)-- Green eggs	Eyed eggs (90%)	Fry (Unfed) (95%)	Fingerling (Fed Fry) (90%)	Adult Returns of Unfed Fry (1%)	Adult Returns of Fed Fry (2%)
			---(% Survival Goals from Previous Stage to this Stage)---				
Cannery Creek	1978 Cannery Creek	3,115,116	2,679,000 1/ (86%)	2,170,000 (89%)			
		923,858 2/		651,040 (70.5%)			
					3/		
Tutka Bay	1978 Tutka Creek	12,658,228	10,170,000 (79.4%)	9,698,922 3/ (95%)			
Kitoi Bay	1978 Big Kitoi Creek	22,840,944	19,205,396 (85%)	17,639,015 3/ (91.8%)			

1/ Incubated at Port San Juan
2/ Streamside incubation
3/ Number released

TABLE 11
SUMMARY OF PRODUCTION OF PINK SALMON FROM SOUTHEAST REGION F.R.E.D. DIVISION FACILITIES
1979

Facility	Brood Year, Brood Stock	--Number Produced/(Actual % Survivals from Previous Stage to this Stage--) Green eggs	Eyed eggs (90%)	Fry (Unfed) (95%)	Fingerling (Fed Fry) (90%)	Adult Return of Unfed Fry (1%)	Adult Return of Fed Fry (2%)
		---(% Survival Goals from Previous Stage to this Stage)------					
Starrigavan	1978 Starrigavan Creek	2,481,551	2,300,398 (92.7%)	2,260,461 1/ + 14,400 2/ (98.9%)	10,812 1/ (75.1%)		
	1978 Irish Creek	465,157	417,516 1/ (89.8%)				

1/ Number released or planted.
2/ Fry held for OTC marking experiment. Of this group 12,000 were transferred to salt water rearing pens.

TABLE 12

SUMMARY OF PRODUCTION OF CHUM SALMON FROM CENTRAL REGION F.R.E.D. DIVISION FACILITIES
1979

Facility	Brood Year, Brood Stock	--Number Produced/(Actual % Survivals from Previous Stage to this Stage)-- Green eggs	Eyed eggs (90%)	Fry (Unfed) (95%)	Fingerling (Fed Fry) (90%)	Adult Returns of Unfed Fry (1%)	Adult Returns of Fed Fry (2%)
			---(% Survival Goals from Previous Stage to this Stage)---				
Tutka Bay	Port Dick	1,200,000	684,013 (57%)	737,408 1/ (108%)			
Clear AFS	Delta River	110,000	105,250 (93.4%)	90,500 2/ (86%)			
Cannery Creek	Wells River	667,020		21,000 2/ (3%)			

1/ Revised estimate. Previous count was wrong. 732,000 released; 5,000 used in rearing experiment.
2/ Number released.

TABLE 13

SUMMARY OF PRODUCTION OF CHUM SALMON FROM SOUTHEAST REGION F.R.E.D. DIVISION FACILITIES

1979

Facility	Brood Year, Brood Stock		--Number Produced/(Actual % Survivals from Previous Stage to this Stage--) Green eggs	Eyed eggs (90%)	Fry (Unfed) (95%)	Fingerling (Fed Fry) (90%)	Adult Return of Unfed Fry (1%)	Adult Return of Fed Fry (2%)
			---(% Survival Goals from Previous Stage to this Stage)------					
Beaver Falls	1978	Beaver Falls - Disappearance Cr.	5,176,069	4,455,746 (86.1%) 2/	2,426,174 1/ (54.5%)			
Klawock	1978	Klawock River	289,432	261,543 (90.4%)	245,192 (93.7%)	232,779 1/ (94.9%)		
Hidden Falls	1978	Kadashan	2,191,987	1,982,770 (90.5%)	1,928,386 (97.3%)	1,678,212 1/ (87.0%)		
	1978	Clear River	332,590	300,385 (90.3%)	281,756 (93.8%)	210,972 1/ (74.9%)		
Snettisham	1978	Prospect Creek	43,262	39,873 (92.2%)	22,616 (56.7%) 3/	22,083 1/ (97.6%)		
	1978	Limestone Creek	107,593	102,455 (95.2%)	101,318 (98.9%)	93,839 1/ (92.6%)		
Starrigavan	1978	Starrigavan Creek	3,383	3,146 (93.0%)	3,127 1/ (99.4%)			
	1979	Irish Creek	790,270	468,721 1/ 146,000 4/ (78%)				

1/ Number released or planted.

2/ Includes two experimental incubators; without these, survival from green to eyed egg would have been 92.2%.

3/ One EDO (R14) was lost when water inflow was interrupted for several hours.

4/ These fish hatched before they could be planted, and had to be killed as a precaution against disease.

TABLE 14
SUMMARY OF PRODUCTION OF STEELHEAD TROUT FROM SOUTHEAST REGION F.R.E.D. DIVISION FACILITIES
1979

Facility	Brood Year, Brood Stock	--Number Produced/(Actual % Survivals from Previous Stage to this Stage--) Green eggs	Eyed Eggs (90%)	Fry (95%)	Fingerling (90%)	Smolt (80%)	Adult Returns (8%)
			---(% Survival Goals from Previous Stage to this Stage)------				
Deer Mountain	1978 Ketchikan Creek	12,850	11,850 (92.2%)	11.559 (97.5%)			
	1979 Ketchikan Creek	6,111	6,111 (100.0%)	5,165 (84.5%)			
Klawock	1979 Klawock River	25,663	5,878 (22.9%)	4,111 (69.9%)			

TABLE 15
1979 EGG TAKE SUMMARY

Facility	Brood Stock	Species	Number of Eggs Taken	Number of Fish Spawned or Killed During Egg Take	Estimated Escapement*
SOUTHEASTERN REGION					
Beaver Falls	Beaver Falls	Chum	2,605,000	2,790	1,197
Crystal Lake	Andrews Creek	King	150,000	55	418
	Duncan Salt Chuck	Coho	119,000	92	NA
Deer Mountain	Cripple Creek	King	239,000	46	702
	Ketchikan Creek	Coho			
	Ketchikan Creek	Steelhead	6,000		
Hidden Falls	Kadashan	Chum	4,029,000	2,214	10,520
	Clear River	Chum	210,000	158	2,816
Irish Creek**	Irish Creek	Pink	476,000	380	NA
	Irish Creek	Chum	843,000	611	NA
Klawock	Klawock River	Chum	256,000	227	1,973
	Klawock River	Coho			
	Klawock River	Steelhead	26,000	19	1,881
Snettisham	King Salmon River	King	34,000	12	76
	Prospect River	Chum	37,000	37	225
	Limestone Creek	Chum	171,000	153	464
		SOUTHEASTERN Total	9,201,000		

*Does not include fish used for egg takes.

**Eggs were eyed at Starrigavan and planted in the stream bed at Irish Creek above the fish ladder.

(CONTINUED)

TABLE 15
(CONTINUED)
1979 EGG TAKE SUMMARY

Facility	Brood Stock	Species	Number of Eggs Taken	Number of Fish Spawned or Killed During Egg Take	Estimated Escapement*
CENTRAL REGION					
Anchorage Area Hatcheries	Crooked Creek	King	531,000	181	3,544
	Tolsona Lake	Grayling	519,000		
	Swanson River	Rainbow Trout	1,255,000		
	Talarik River	Rainbow Trout	320,000		
Big Lake	Meadow Creek	Sockeye	5,054,000	2,548	25,000
	Nancy Lake	Sockeye	992,000	487	3,621
	Fish Creek	Coho	928,000	489	3,400
Cannery Creek	Cannery Creek	Pink	1,234,000	1,119	7,590
	Jonah Creek	Pink	2,316,000	2,100	155,100
	Siwash	Chum	615,000	452	3,380
Clear	Delta River	Chum	300,000	160	5,000
East Creek	Francis Creek	Sockeye	6,200,000	2,400	30,000
Karluk (Devil's Creek)	Thumb River	Sockeye	6,400,000	3,200	11,000
	Chignik	King	200,000	40	1,200
Kasilof	Glacier Flat	Sockeye	3,000,000	1,512	3,500
	Bear Creek	Sockeye	3,000,000	1,512	14,500
Kitoi	Kitoi Creek	Pink	28,300,000	21,000	15,000
	Kizuyak River	Chum	50,000	40	25,000
Russell Creek	Russell Creek	Chum	7,300,000	4,200	13,000
Tutka	Tutka Creek	Pink	10,643,000	10,044	10,600
	Tutka Creek	Chum	6,000	3	100
		CENTRAL Total	79,163,000		
		GRAND Total	88,364,000		

* Does not include fish used for egg takes.

TABLE 16

FRED DIVISION EGG-TAKE OBJECTIVES FOR 1980

Incubation Site	Brood Stock, Species	Number of Eggs
CENTRAL REGION		
Anchorage Area Hatcheries	Crooked Creek, kings	2,000,000
	Swanson River and Talarik River, rainbow trout	4,400,000
	Seward, coho	2,600,000
Big Lake	Meadow Creek and Nancy Lake, sockeye	16,000,000
	Fish Creek, coho	4,000,000
Cannery Creek	Cannery Creek, pink, and Siwash Creek, chum	10,000,000
Clear	Delta River, chum	520,000
	Clear Creek, king	125,000
	Clear Creek, coho	50,000
	Tolsona Lake, grayling	950,000
	Koyukuk, sheefish	400,000
East Creek	Francis Creek and Lake Nunavaugaluk, sockeye	15,000,000
Karluk	Thumb River, sockeye	25,000,000
Kasilof River	Tustumena Lake, sockeye	20,000,000
Kitoi Bay	Kitoi Creek, pink and chum, and Sturgeon River, chum	29,000,000
	Chignik River, king	300,000
Main Bay	Cannery Creek, pink, and Wells River, chum	2,000,000
Russell Creek	Russell Creek, chum and pink	19,100,000
Tutka Bay Lagoon	Tutka Creek, pink	15,000,000
	Port Dick, chum	5,000,000

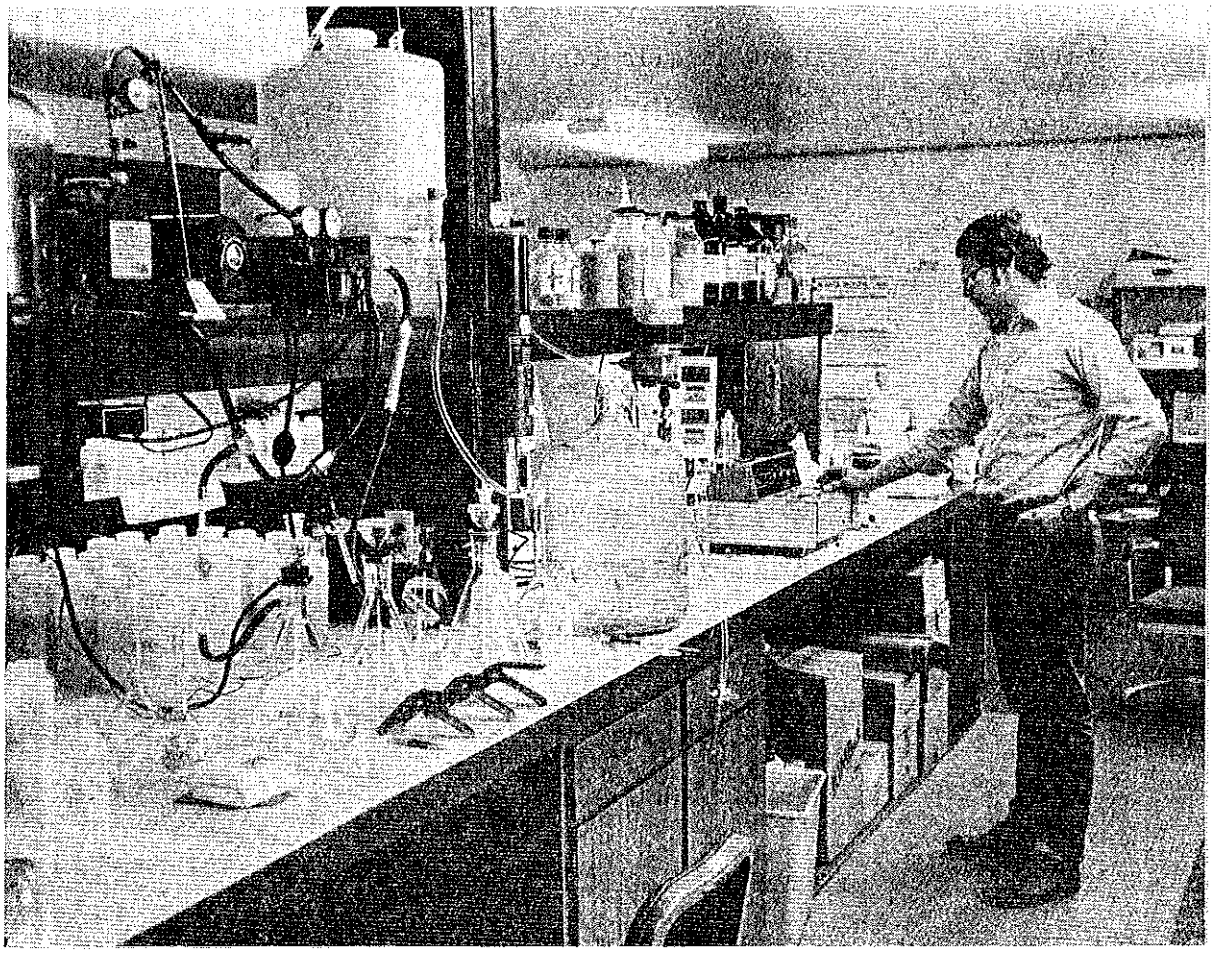
-continued-

TABLE 16
(continued)

FRED DIVISION EGG-TAKE OBJECTIVES FOR 1980

Incubation Site	Brood Stock, Species	Number of Eggs
SOUTHEASTERN REGION		
Beaver Falls	Beaver Falls returns, chum	5,000,000
Crystal Lake	Crystal Creek, chum	300,000
	Andrews Creek, king	100,000
	Duncan Salt Chuck and Crystal Creek, coho	1,500,000
	Crystal Creek, steelhead	80,000
Deer Mountain	Cripple Creek, king	200,000
	Ketchikan Creek, coho	250,000
	Ketchikan Creek, steelhead	15,000
Hidden Falls	Kadashan Creek and Long Bay, chum	10,000,000
	Site not yet chosen, coho	500,000
Klawock	Klawock River and another location not yet chosen, chum	10,000,000
	Klawock River, coho	1,900,000
Snettisham	Neka River and Limestone Creek, chum	4,000,000
	King Salmon River, king	200,000
	Speel Lake, coho	200,000
	TOTAL	205,690,000

TECHNOLOGY AND DEVELOPMENT



Dr. Jeff Koenings tests equipment in the new limnology lab in Soldotna. (ADF&G photo by Mark Kissel)

TECHNOLOGY AND DEVELOPMENT

The disciplines of biology, engineering, fish culture, genetics, limnology, and pathology are represented in the Technology and Development (T&D) branch. Collectively, this branch is responsible for quality control, research, development, and the continued improvement of the technology used in the FRED program.

Fish culture

The division has pioneered in the area of incubation substrates since 1974. Astroturf was used as a substrate until plastic Intalox saddles were found to produce better quality fry. After three years of use, the plastic saddles have proven their efficacy. Fry size and hatchery survivals have been generally greater for saddle-incubated fry than for those incubated in other plastic substrates or with no substrates. Fry quality has been equal or similar to gravel-incubated fry. The emergence of saddle-incubated fry occurs at nearly the same time as wild fry, and initial adult returns indicate similar marine survivals. Although FRED incubators generally performed satisfactorily, modification is needed to increase their efficiency. Such action is especially needed at facilities where suspended particulate matter in the water supply tends to clog the incubators.

Studies at the Tutka Bay Lagoon Hatchery confirmed reports from Japan that some races of chum salmon cannot be transferred directly from the hatchery to sea water without killing a significant number of them. Hatchery planners, therefore, must consider freshwater chum rearing units at hatcheries where brackish-water estuaries do not exist.

Preliminary designs were drawn for marine rearing pens that will, it is hoped, eliminate many of the problems of conventional pens, such as fouling, fish stress, and high labor intensity. Development will begin when funds become available. In addition, studies are continuing at Hidden Falls Hatchery on the suitability of TESS rearing pens. The hexagonal pens, supported by a tepee-like frame of fiberglass poles, are inexpensive and able to survive stormy seas.

New rearing containers, called silos, were tested at the Snettisham Hatchery during 1979. Each silo measures 17.5 feet high by 7 feet in diameter. They are intended for rearing at hatcheries with limited floor space. It may be possible to rear as many as 1 million chum fry in each silo.

A prototype "fry/water separator" was tested during 1979. This device separates emerging fry from the incubator's water system and channels them to holding tanks or release areas. This allows fish culturists to stack incubators on top of each other without endangering emerging fry.

Stacked incubators save hatchery floor space, an expensive item in Alaska. As a result of these tests, a production model should be ready for 1980.

An electronic device was used during 1979 to count fry as they emerged from incubators. Perfection of this counter will save manpower and time. The device can also count fingerlings and smolts and will result in more accurate counts of fish.

Sheefish eggs were taken in fall of 1978 and the resulting fry, about 26,000 of them, were released into landlocked lakes in spring of 1979. The purpose of this program is to develop incubation methods for sheefish and to provide sheefish sport fishing throughout the Interior. FRED is also working on incubation techniques for grayling, and released 30,000 young grayling into Tolsona Lake during 1979.

A comprehensive fish culture manual was produced under the direction of lead technologists, and long-range operational plans were prepared for each FRED hatchery. FRED fish culturists also assisted in arrangements for the Bio-Engineering Symposium held in Traverse City, Michigan, and several attended this professional meeting.

Biology

Chum salmon enhancement has been successful at the Beaver Falls Hatchery. In 1978 and 1979, between 0.5 and 1% of the fry released have returned as adults. This is considered good for a transplanted stock. Now, with eggs being taken from the returning fish, biologists expect the stock to adapt itself to the new location, increasing marine survivals. Studies of these fish have yielded valuable data on "imprinting," the process by which salmon locate and return to their natal stream. Mark and tag recovery data from Beaver Falls chums indicate that the fish are exposed to traditional commercial fisheries for about 5 months of their marine life.

Other studies are underway to find the best way of utilizing the chinook and coho salmon fry production capabilities of hatcheries such as Snettisham, Klawock, and Hidden Falls. Coho fry were planted in a lake near one of these hatcheries after most of the predators were removed. Biologists will monitor smolt out-migration and adult returns so that managers can make enlightened decisions regarding the channels for future production. Studies of lake-stocked sockeye salmon at Leisure Lake indicated that lake stocking of this species can be very effective.

The adult returns to the Tutka Bay Lagoon Hatchery during 1979 show that short-term rearing of pink salmon fry can nearly double their subsequent ocean survival. Short-term rearing means that the fry are held at the hatchery and fed until the time of natural migration or until estuarine productivity is optimum. The release of fry into the estuary is timed

to coincide with increases in the natural food supply. Data from the Kitoi Hatchery appear to substantiate the Tutka findings. However, funds have not been available to evaluate the returns adequately. Related data are expected soon from the Beaver Falls Hatchery.

FRED biologists are involved also in the following major activities:

1) Statewide evaluation of adult returns from hatchery releases.
2) Statewide evaluation of various technologies used in hatchery operations and rearing projects.
3) Examining the feasibility and potential of proposed hatcheries.
4) Evaluation of existing fishways statewide, and compiling an inventory of potential fishway sites.
5) Surveying Southeast Alaskan watersheds to determine whether rearing areas can be developed adjacent to rivers to increase coho production.
6) Evaluating egg and fry plants above new fishways in Southeastern and Central Alaska.
7) Studying the effectiveness of half-length coded wire tags.
8) Evaluating the lake rearing of coho and chinook juveniles in cooperation with the National Marine Fisheries Service at Little Port Walter.
9) Rehabilitation of depressed sockeye stocks on Kodiak Island mainly through the planting of eyed eggs in stream gravel.
10) Studying the use of several Lower Cook Inlet lakes for winter rearing of hatchery-bred sockeye juveniles.
11) Selecting and developing brood stocks for hatcheries at Main Bay, Cannery Creek, Snettisham, Hidden Falls, Klawock, Deer Mountain, Beaver Falls, and Russell Creek.
12) Evaluating the stocking of cohos in Prince William Sound, Resurrection Bay, and Kachemak Bay, where sport fisheries have been created or enhanced.
13) Studying coho enhancement that resulted from habitat improvement work with the aim of producing 50,000 additional adults for the area of Upper Cook Inlet.
14) Continuing to control predation by char and beluga whales upon sockeye populations in Bristol Bay.
15) Studying the life histories of chinook salmon in Central Cook Inlet and applying that knowledge to increase the efficiency of FRED's efforts. Studying the saltwater rearing of pink salmon and sockeye salmon.
16) Gathering information on lake productivity for use in FRED lake fertilization and lake stocking projects in Southeastern, Central, and Western Alaska.

FRED personnel have taken a lead in professional societies and seminars. A FRED biologist will head a panel at the 1980 Pink and Chum Workshop in Sitka. Another FRED employee is president of the Alaska Chapter of the American Fisheries Society and is organizing the 1980 meeting in Kodiak. Others serve on the Alaska Council of Science and Technology and legislative groups dealing with aquaculture.

Limnology

The FRED Division requested and received C.I.P. funding in FY 77 and FY 78 for the inventory of freshwater sources of the state. These projects were the forerunners of the operationally budgeted limnology projects initiated in FY 79. The limnology projects in the Southeastern and Central Regions have focused on the potential for increasing the productivity of lakes through the addition of commercial fertilizers. They also seek to identify underutilized waters for possible salmon stocking.

During FY 80 a limnology laboratory was formed at Soldotna. There, all water and biological samples collected for limnological projects throughout the state are processed. The limnologist in charge of the Soldotna lab was named leader of a departmental team to develop guidelines for the artificial fertilization of lakes. These guidelines were necessary because the U.S. Forest Service (U.S.F.S.) and regional aquaculture associations became interested in developing lake fertilization and lake stocking projects.

The limnology staff is active also in the following projects:

1) A coho lake stocking project in cooperation with the U.S.F.S. and the Northern Southeast Regional Aquaculture Association of Baranof Island.
2) Analyzing water samples from proposed hatchery sites to determine water quality and suitability.
3) Analyzing water samples from existing facilities to determine the efficiency of their water treatment systems.
4) Matching the water quality of natal streams of potential donor stocks with the water quality at the incubation site. By closely matching these, fish culturists and biologists hope to increase egg survival.

Pathology

A fish pathology laboratory is operated by the FRED Division at Anchorage. In FY 79, an extension of that laboratory was located at Juneau, but FY 80 budget cuts forced that facility to close.

The pathology program provides routine diagnostic services for all hatcheries in Alaska, including private facilities. Pathologists also screen stocks of fish proposed for hatchery use. In addition, they investigate the occurrence and frequency of diseases in natural salmon stocks for the purpose of determining the implications of those diseases on the infected stocks.

Pathology must provide services to an increasing number of state and private hatcheries. In addition, the prevalence of disease in natural stocks indicates that the survey of natural stocks should be increased.

The fish pathology staff streamlined its technique for diagnosing infectious hematopoietic necrosis virus (IHNV). This virus was the cause of a mass mortality at the Big Lake Hatchery in 1979. Reliable diagnoses can now be obtained in a short time (two to three weeks), at less cost than before. Research at Lake Nerka in Bristol Bay indicates that hormones can be utilized to speed maturation of adult sockeye, thus reducing pre-spawning mortalities. This method is also being evaluated as a possible IHNV control. IHNV vaccine has been produced in cooperation with the Department of Health and Social Services Virology Rabies Unit and will be tested for potency. Researchers are seeking a practical method of controlling this disease that is common among wild stocks.

Bacterial kidney disease (BKD) continues to cause mortality among a variety of fish in Alaska. To cope with the many samples and requests for identification of this agent, additional laboratory personnel received training in fluorescent microscopy. This method allows rapid identification of the causative agent for BKD within hours after receiving samples at the laboratory. This technique was used on-site at the Crystal Lake Hatchery to screen infected adults from the hatchery brood stock.

Studies of soft shell disease in king and tanner crabs have led to the discovery of a bacterial agent which is pathogenic to tanner crabs. This agent has been isolated from Adak king and tanner crabs. The relationship of this organism to the disease will be further elucidated.

A pathogen not previously found in Alaska has been isolated from fish at Fort Richardson. It is a strain of the enteric redmouth bacterium, but it appears to be less virulent than the one found in the Lower 48.

Genetics

FRED's fish geneticist, now stationed in Anchorage, has been screening potential hatchery brood stocks and developing a rainbow trout brood stock for the Fort Richardson Hatchery. He and his staff develop genetic profiles of stocks through examination of samples in the laboratory. The profiles reveal genetic variability within stocks; a reduction in variability indicates reduced fitness for survival. The profiles can also be used to determine variability between stocks as well. In the future, hatchery fish may be genetically "marked" to allow estimation of FRED's contribution to a mixed fishery. During 1979, profiles were developed on 17 potential brood stock populations, which are presented in Table 17.

The work of the genetics section protects the gene pool of wild salmon stocks, and maintains the viability of hatchery brood stocks.

Engineering

Division engineers have been involved in 46 major projects during 1979. The section provides nine basic services to the Division. These are: field investigations, conceptual planning, in-house designing, consultant design administration, project inspection, in-house construction,

in-house engineering consultation, coordination with Department of Transportation and Public Facilities, and coordination with other agencies. A list of major projects that required the services of the engineering section is found in Table 18. FRED engineers provide service to all divisions within the Department of Fish and Game. In addition, FRED engineers hosted the 1979 meeting of the American Association of Conservation Engineers in Juneau.

FRED reports

A bibliography of FRED publications is available from the Juneau office upon request. All projects and facilities report annually. In addition, research projects and information which expands technical knowledge are reported in technical journals.

TABLE 17

SALMON STOCKS SCREENED GENETICALLY
DURING 1979 BY SPECIES

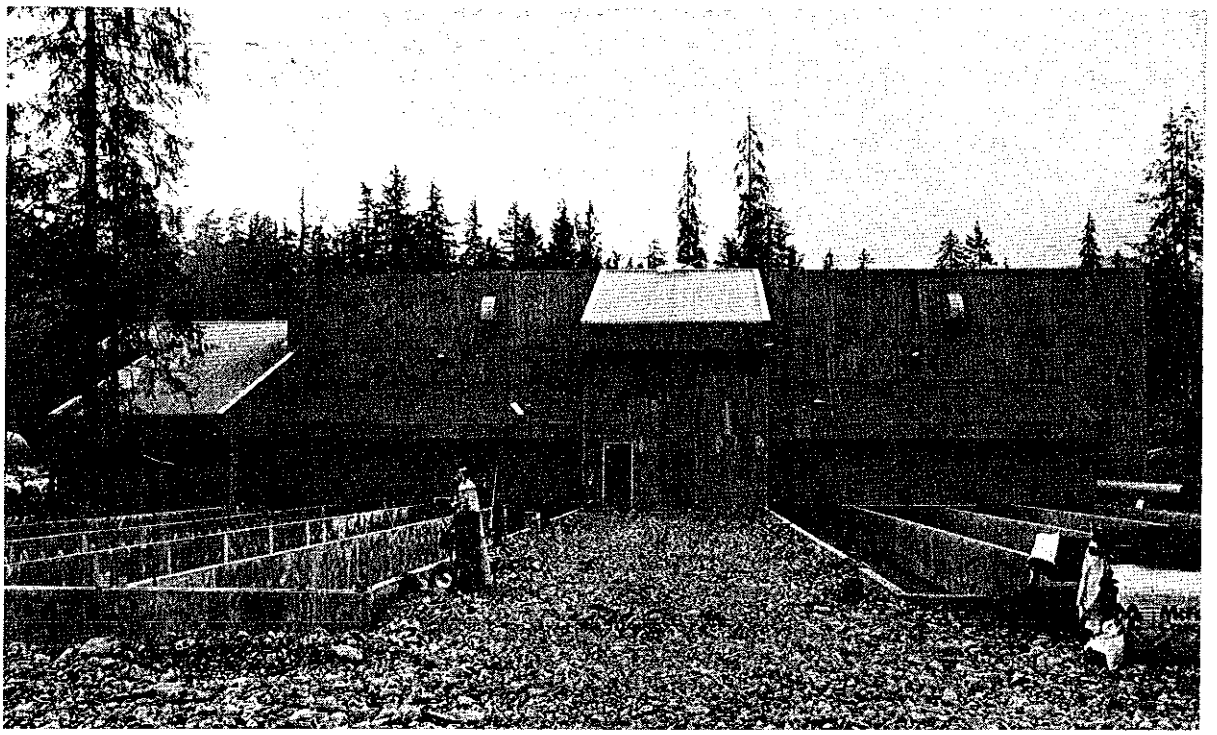
SPECIES	LOCATION
Kings	
	Anderson Creek
	Crooked Creek
	King Salmon River
	Ship Creek
Sockeyes	
	Karluk Lake (fry only)
Pinks	
	Cosmos Cove
	Hamilton Creek
	Irish Creek
Chums	
	Clear River
	Crystal Creek
	Disappearance Creek
	Hamilton Creek
	Irish Creek
	Kadashan Creek
	Limestone Creek
	Prospect Creek
	Tunehean Creek

TABLE 18

LIST OF MAJOR PROJECTS INVOLVING
FRED ENGINEERS IN 1979

Project Name
1) Anchorage Area Hatcheries
2) Cannery Creek Hatchery
3) Big Lake Hatchery Expansion
4) Russell Creek Hatchery
5) Tutka Lagoon Hatchery Expansion
6) Lake Nunavaugaluk Access Road
7) Karluk/Kitoi Incubation
8) Trail Lakes Water Study
9) Trail Lakes Hatchery
10) Clear AFS Hatchery
11) Kasilof Hatchery
12) Main Bay Hatchery
13) Kotzebue Area Hatchery
14) Kizhuyak (Terror Lake) Hatchery
15) Snettisham Hatchery (Two Phases)
16) Upper Log Jam Creek Fishpass
17) Hidden Falls Hatchery
18) Hidden Falls Hydro
19) Irish Creek Fishpass
20) Lake Nunavaugaluk Housing
21) Tutka Lagoon Housing
22) Tutka Lagoon Bunkhouse
23) Cannery Creek Housing
24) Russell Creek Housing
25) Klawock Hatchery Housing
26) Hidden Falls Housing
27) Russian River Fishpass
28) Frazer Lake Fishpass
29) Chignik Weir
30) Kenai River Sonar Site Survey
31) Cordova Warehouse
32) Copper River Sonar Site
33) Seward Fish Trap
34) Birch Lake Screens
35) Kenai River Fish Trap
36) Fairbanks Air Conditioner
37) Snake River Weir
38) Tolsona Lake Outlet Structure
39) Beaver Falls Hatchery
40) Starrigavan Floating Pumphouse
41) Swan Lake Hatchery Planning
42) Dillingham Warehouse
43) Sandpoint Housing
44) Dutch Harbor Warehouse
45) Palmer Warehouse
46) Big Lake Wells

HATCHERIES, FISH PASSES, AND HABITAT ALTERATION



The nearly-completed FRED hatchery at Cannery Creek in Prince William Sound. (ADF&G photo by Mark Kissel)

HATCHERIES, FISH PASSES, AND HABITAT ALTERATION

State hatcheries

Hatcheries are used as a production base for salmon rehabilitation and enhancement programs because they are roughly 800 percent more efficient in converting eggs to fish than the natural environment. The hatchery process shortens the time required to rehabilitate depleted stocks. FRED's hatcheries have been funded largely through state bond issues in 1976 and 1978. These facilities represent large capital investments, which have been supported by the Administration, Legislature, and voting public. Table 19 presents a list of public hatcheries and details of their operations, including the years in which they began operations or plan to begin operations. Note the new hatcheries beginning operations in fiscal years 1980 and 1981. Most of these new hatcheries are big production facilities with large egg capacities.

Fish passes

In addition to hatcheries, FRED has been involved in the construction, maintenance, and utilization of fish passes throughout the state. Fish passes not only open new spawning and rearing areas to salmon, but also protect and extend existing runs. A list of fish passes, grouped by region, is presented in Table 20. Many of these passes were the result of cooperation between ADF&G and the federal government, especially the U.S. Forest Service.

Fish passes are effective, as proven by the strong run of sockeye to Frazer Lake every year. Prior to the installation of the fish pass, the lake was inaccessible to anadromous fishes because of a barrier waterfall. Now, the potential of the lake is being realized. A fish ladder on Ketchikan Creek helped boost its natural production. This year, for example, pinks returned in numbers that prompted the first salmon sport fish opening there in recent memory.

Habitat alteration

During 1979, FRED created a foundation for lake fertilization projects on a statewide and cooperative basis. Superficially, lake enrichment seems little more than adding fertilizer to lake water, an easy and inexpensive means of producing more salmon by increasing their freshwater food supplies. However, tasks associated with effective lake enrichment programs require a highly-trained staff and laboratory facilities. The successful program increases survival of young salmon by providing food that is in low supply naturally. Algal populations increase by utilizing the fertilizer, and pass this increase along the food chain to salmon. The process must produce organisms that salmon will eat, and they must be produced in the right place and at the right time. Most importantly, organisms resulting from fertilization must not disturb the balance of existing plankton in the lake. Lake fertilization guidelines and policies were written and approved by ADF&G Division heads and the Commissioner in 1979.

The lake enrichment guidelines define three stages for projects. In the pre-fertilization phase, the lake is studied in detail at least one full year prior to any application of fertilizer. This study is necessary to ensure that the addition of fertilizer does not harm the ecology of the lake. The fertilization phase begins when fertilizer is added to the system, in the prescribed amounts and exact atom ratios necessary, and at the proper time to increase food for rearing fry. The third is the post-fertilization phase, during which the lake system is monitored to evaluate the project and to correlate changes in the lake's productivity with the application of additional fertilizer.

Beginning in July, 1979, lakes have been identified for possible inclusion in the lake fertilization program. FRED and the Southern Southeast Regional Aquaculture Association (SSRAA) began a joint pre-fertilization study on three lake systems: Klawock, Hetta and Hugh Smith. Klawock Lake has since been dropped from consideration, and two other lakes, McDonald and Salmon Bay, added to a preliminary feasibility study.

FRED and the U.S. Forest Service (U.S.F.S.) began identifying possible enrichment targets in the Prince William Sound area. Thus far, Esther, Eshamy, and Solf lakes have been sampled. The City of Cordova is also interested in supporting lake fertilization in Prince William Sound. FRED and the U.S.F.S. have also begun sampling lakes on Baranof Island and the Tongass National Forest. Redoubt, Kamalka, Politofski, Cutlaku, Kah-Sheets, and Thoms lakes have either been sampled or are under active consideration for lake enrichment sampling. FRED is also sampling Karluk Lake on Kodiak Island.

In Cook Inlet, two lake systems, Crescent and Bear, are being studied for potential lake fertilization. In addition, Hidden and Russian lakes are being studied to document the effects of salmon carcasses on lake fertility; this study will test theories at the heart of the lake fertilization program. FRED is also cooperating with the Cook Inlet Native Association in an on-the-job training program for lab technicians. Funds are provided entirely by the association in exchange for FRED limnological training.

Stream clearance projects begun in 1977 on the Kupreanof Peninsula on the Alaska Peninsula successfully provided access for spawning pink salmon. Adult returns to the streams numbered more than 2,000 in 1979, an 8 to 1 ratio of returns per spawner. The streams had been blocked for years by log jams. In other areas, FRED personnel continued in 1979 to remove beaver dams that could interfere with salmon migration.

FRED personnel held more than 3,200 arctic char in net pens at the mouth of the Agulowak River in the Bristol Bay region during the out-migration of sockeye juveniles in 1979. The char, if left free, would have devoured an estimated 287,000 young salmon. About 2.7% of the impounded char died in captivity. This predator control project was begun by the Division of Commercial Fisheries and was shifted to FRED in 1979.

TABLE 19
Status of State Hatcheries
1979

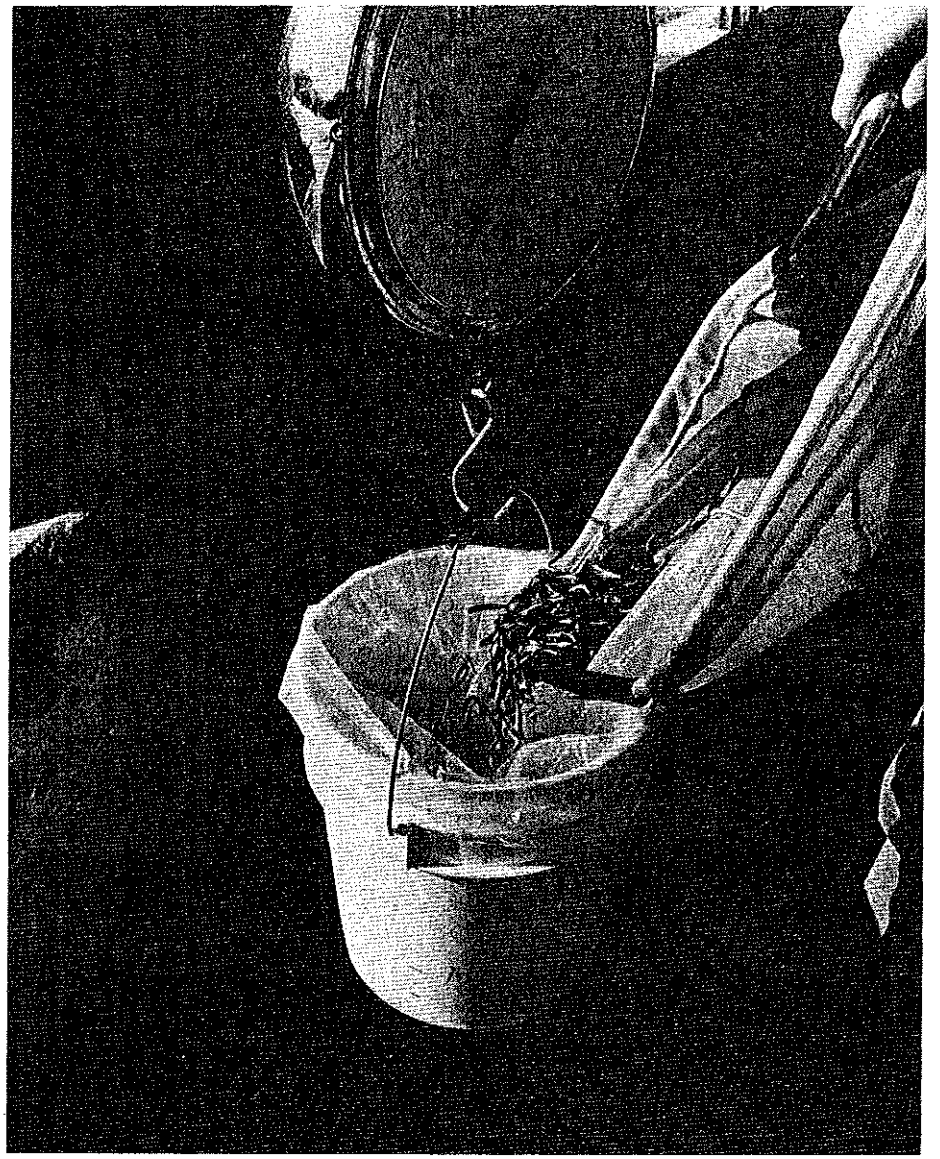
Year on Line	Facility	Location	Primary Species	Egg Capacity (millions)	Status	Benefit/Cost
FY 62	Ft. Richardson*	Anchorage	rainbow/coho	8.6	operational/expanding	1.4
FY 72	Crystal Lake	Petersburg	king/coho	5.8	operational	2.0
FY 73	Starrigavan	Sitka	chum/coho		changed over to rearing and eyeing station	
FY 73	Halibut Cove Lagoon	Halibut Cove	king/coho		changed over to release station	
FY 76	Beaver Falls	Ketchikan	chum	5.0	operational	1.7
FY 77	Deer Mountain	Ketchikan	king/coho/steelhead	0.4	operational	2.1
FY 77	Big Lake	Wasilla	sockeye/coho	20.0	operational/expanding	3.6
FY 77	Kasilof	Kasilof	sockeye	10.0	operational/expanding	2.6
FY 77	Tutka Lagoon	Kachemak Bay	pink/chum	20.0	operational/expanding	1.5
FY 77	Kitoi Bay	Afognak Is.	pink/chum	25.0	operational/brood stock development	2.2
FY 78	Ship Creek	Anchorage	king	2.0	operational/upgrading	1.4
FY 79	East Creek	Dillingham	sockeye	15.0	operational	2.6
FY 80	Russell Creek	Cold Bay	chum/pink	52.0	operational/shakedown	1.7
FY 80	Hidden Falls	Baranof Is.	chum/coho	65.0	operational/shakedown	4.5
FY 80	Klawock	Klawock	chum/coho	78.0	operational/shakedown	6.0
FY 81	Cannery Creek	Prince William Sound	chum/pink	39.0	construction/brood stock development	2.1
FY 81	Clear AFS	Clear AFS	chum/king/grayling/sheefish	1.8	pre-construction	Research
FY 81	Snettisham	Juneau	chum/coho	75.8	construction/brood stock development	6.2
FY 82	Main Bay	Prince Wm. Sound	chum	65.0	design/brood stock development	2.1
FY 82	Karluk Lake	Kodiak Is.	sockeye	50.0	operational/expanding	1.8
FY 82	Trail Lakes	Moose Pass	sockeye/king/coho	77.0	design	5.5
FY 83	Kotzebue	Kotzebue area	chum	10.0	site selection/conceptualization	ND
			TOTAL	635.4		

* Also known as the Anchorage Area Complex when combined with the Ship Creek facility. A third Anchorage area hatchery, Fire Lake, no longer operates.

TABLE 20
Fish Passes in Alaska
1979

Area	Location
Southeastern	Anan Creek
	Bakewell Creek
	Falls Creek
	Irish Creek
	Ketchikan Creek
	Navy Creek
	Pavlof Creek
	Survey Creek
Kodiak	Frazer Lake
	Little Kitoi Creek
	Paul's Lake
	Portage Lake
	Seal Bay
	Waterfall Creek
Prince William Sound	Billy's Hole
	Control Creek
	Hobo Creek
	Shrode Creek
Cook Inlet	Russian River

HATCHERY BROOD STOCK DEVELOPMENT AND SALMON EGG NEEDS



Chum salmon fry destined for the brood stock development project at the new Hidden Falls Hatchery are weighed prior to transport. (ADF&G photo by Mark Kissel)

HATCHERY BROOD STOCK DEVELOPMENT AND SALMON EGG NEEDS

Brood stock development

With the completion of several major production hatcheries, the problems of brood stock development come to the fore. FRED carefully selects brood stocks, considering pathological and genetic factors among others, and works to develop these stocks to the necessary level. Such development takes years; the time varies with the species under development. Stocks of pink salmon, which have a two-year life cycle, can be developed much faster than chum salmon, which have a four-year life cycle. Figure 2 shows that a 66-million-egg chum salmon hatchery, beginning with a brood stock of 1,800 adults, can be filled after eight years of brood stock development. The first full returns, therefore, occur 12 years after the first egg take. The following is a description of the brood donor stocks for various hatcheries, the potentials, and the problems that may be encountered. Table 16 in the first section of this report is a summary of 1980 egg take goals.

CENTRAL REGION

CANNERY CREEK BROOD STOCKS: The 1980 goal is to take 10 million pink salmon eggs for the new hatchery. About two-thirds of these, or more if available, will come from Cannery Creek stock, which will include returns from previous hatchery releases. The rest may be taken from Jonah Creek, which may have a return of about 7,400 fish. If these systems fail to produce sufficient numbers of returning adults for the egg take, a large return (45,000) is expected at Siwash Creek. With these brood stocks available, no problems are anticipated. FRED will also seek to take 1.5 million eggs from Hobo Creek to enhance the area above the fish ladder there. Projected escapements to Hobo Creek are not good, however, and eggs may have to be taken from Jonah or Siwash creeks to achieve goals for this project.

Chum salmon eggs are also requested for hatchery use in 1980. About 14,000 chums are expected to return to Wells River. Chum brood stock will be allocated based upon pre-established stock management criteria.

BIG LAKE STOCKS: Much of the sockeye and coho production of the hatchery is caught in the Central Cook Inlet District. This year, for example, a four-day closure in that district during the historical peak of the run resulted in an escapement of more than 68,000 sockeye to the Big Lake watershed. This is the largest escapement there in 19 years. Further, these returns represent a 35 percent smolt-to-adult survival. This high rate shows the productive potential of the Big Lake system.

Brood stock requirements are these: to incubate 13 million sockeye eggs, a run of 20,000 sockeye is needed. To incubate 1 million coho eggs, a run of 3,500 cohos is required. The Big Lake Hatchery cannot rehabilitate the upper Cook Inlet salmon runs if the lake system receives an escapement of only 3,000 to 6,000 fish, as it has in past years.

ANCHORAGE AREA HATCHERY COMPLEX BROOD STOCKS: King salmon from Crooked Creek on the Kenai Peninsula should be available in sufficient numbers for brood stock. No problems are anticipated in achieving egg take goals of cohos from the Seward area, as these fish mature in the late fall as they ascend Bear Creek and enter Seward Lagoon where weirs and egg take facilities have been in use for several years.

KASILOF BROOD STOCKS: Sockeye salmon eggs for the Kasilof Hatchery come from the Tustumena Lake system. The Bear and Glacier Flats creeks have provided sufficient eggs in past years. The 1980 egg take goal for Kasilof is 20 million, and biologists envision no problems in brood stock availability, even though projections for Bear Creek indicate few fish may be available for egg takes.

Sockeye salmon escapements to the Kasilof River in 1980 are projected to be in the vicinity of 120,000 fish. About 31,200 fish are forecast at Glacier Flats Creek, a spawning area that may become unusable because of a buildup of silt and clay in the stream's substrate. At the same time, an escapement goal of 23,200 is listed for that stream. Moose and Bear creeks, which also flow into Tustumena Lake, have a combined escapement goal of 64,000 sockeyes. The forecast return (based on spawner-recruit relationships) is 66,150 sockeye, which might provide some eggs for the Kasilof hatchery. If the forecasts are accurate, egg-take goals will be met.

King salmon eggs are also collected at the Kasilof hatchery. About 4,600 Crooked Creek kings are expected to return to the Kasilof River in 1980. About 2,460 of those kings are expected to be hatchery fish. The Crooked Creek king salmon run precedes the commercial fishery, and as yet, only about 200 kings are taken annually in the Kasilof River sport fishery. Fewer will be harvested in 1980 if that fishery remains unadvertised. In any event, the run to Crooked Creek is expected to exceed the needs of the natural stock and the hatchery, which requires 2 million eggs. This fishery will increasingly attract sport fishermen as it grows.

TRAIL LAKES HATCHERY BROOD STOCK: Sockeye salmon brood stock for the proposed Trail Lakes hatchery will come from Hidden Lake, and other tributaries to the Kenai Lake system. Projections for beyond 1980 indicate that the incubation potential of the hatchery can be successfully combined with the unutilized rearing potential of Kenai River system lakes. The capacity of the hatchery will be about 65 million eggs, 20 million of which will be king and coho salmon of Kenai River origin. King and coho brood stocks that can provide that many eggs are being identified.

TUTKA BAY LAGOON HATCHERY STOCKS: An excellent hatchery return during 1979 provided all the brood stock necessary for the hatchery. More than 10.7 million pink salmon eggs were taken. The return was so good that four emergency commercial openings were necessary in the lagoon to harvest surplus salmon.

Approximately 21,000 pinks were held for brood stock, of which 6,700 females and 3,350 males were spawned.

If 1980 survival rates are similar to this year's, the 1980 pink return to Tutka will be outstanding. Based on the total release of 9.4 million pink fry (4.8 million direct hatchery release and 4.6 million short-term reared) and survival rates ranging from 2 to 4 percent for the direct release and 5 to 10 percent for those short-term reared, the hatchery return alone could range from 327,000 to 655,000.

The management approach for this anticipated return will be similar to that used during 1979. Early seining will be allowed in order to reduce heavy concentrations of pink salmon within the lagoon. This is important because fish staying in the lagoon color up and soften rapidly, thereby diminishing in commercial value. The early set net harvest will be used as an indicator of the magnitude of the run.

No problems are anticipated in securing brood stock in 1980. The problem lies, rather, with the rapid passage of too many fish into the lagoon. Surplus above natural escapement (10,000-15,000) and brood stock (25,000-30,000) for 18 million eggs may be wasted unless timely management decisions, including emergency openings, are made. Actions by the Commercial Fisheries Division in this regard have been excellent.

A chum salmon egg take in the Outer District was cancelled because of budget cuts, and an egg take in Tutka Creek yielded only 6,000 eggs. A chum egg take at the Port Dick Creek or Island Creek systems has been proposed for 1980. The goal is 2 million eggs; no problem in achieving that goal is anticipated.

KITOI BAY PINK SALMON STOCKS: About 214,000 pinks are expected at Kitoi Bay in 1980. About 45,000 fish will be utilized as brood stock with the remainder available for commercial harvest on a 48-hour Emergency Order basis. This procedure has worked well in past years.

KARLUK LAKE SOCKEYE STOCKS: The management of Karluk sockeye is a complex problem on the west side of Kodiak Island. A strong run of pink salmon to the Karluk River, expected to reach 4.8 to 6.0 million fish in 1980, contributes to the problem of mixed stock - mixed species management. It is apparent that we will have little opportunity to work with late-run sockeye in a fishery concentrated on pink salmon. Therefore, sockeye eggs may be available only from early-run fish which spawn in July and August. A cooperative agreement with the U.S. Fish and Wildlife Service restricts the use of Thumb River sockeye to one-half of the available fish. Nevertheless, an objective of 25 million eggs is intended.

RUSSELL CREEK STOCKS: The 1980 goals for the hatchery are 9.7 million pink salmon eggs (from 8,900 pinks) and 9.4 million chum salmon eggs (from 6,300 chums). Parent escapement for pink salmon was strong (45,000) in 1978. For chum salmon, parent escapements were weak in 1976 (10,600) and strong in 1977 (52,000). These years represent the brood years for the major age-classes expected to return in 1980. Brood stock and escapement goals should be achieved in 1980 based on projections. No significant commercial fishery now exists on Cold Bay stocks. The immediate Cold Bay area, however, should be closed to commercial fishing during appropriate monthly periods until requirements of the stream and hatchery have been satisfied.

EAST CREEK HATCHERY SOCKEYE STOCKS: The objective for this facility in 1980 is 6 million sockeye eggs. This objective is determined by the relative unavailability of sockeye adults returning to the lake and the fact that the hatchery has the capacity to rear only about 5 million fry with its partially functional water system. About 6 million sockeye eggs are authorized from Ualik Lake, which is adjacent to Lake Nunavaugaluk. Token numbers of Lake Nunavaugaluk fish are expected, and all those entering East Creek at the hatchery will be used.

CLEAR HATCHERY STOCKS: The egg take needs of this research and development facility are not large at this time. Its take of Delta River chums was not affected by fisheries in 1979, and probably will not be affected in 1980. An egg take is planned from the Clear Creek kings. This is a small run (60 fish) that may be harmed by a heavy fishery if rehabilitation measures are not taken. An egg take of Clear Creek cohos is not expected to be affected, since that stream is in an area of low human population.

SOUTHEASTERN REGION

KLAWOCK BROOD STOCKS: Only 289,000 chum eggs were taken in 1979, far below the objective of 10 million. Poor escapement (2,500 chums) to the Klawock River was partly the cause. In addition, the sliding egg scale developed in conjunction with the Commercial Fisheries Management Division limited the number of fish that could be used for hatchery brood stock. The Noyes Island fishery is believed to have a major effect on escapement of fish to Klawock. Changes in management strategies might be in order after the assessment of marked fish in the commercial catch provides new information on the timing and distribution of Klawock River and other stocks.

The present strategy of allocating 10,000 adult spawners to the stream while the hatchery receives 5,000 is restrictive. The State has a $3 million capital investment and a $300,000 overhead cost that is not being utilized as well as it might. Pink salmon at Klawock River are being considered for contingency egg takes in the event that a sufficient chum salmon return fails to materialize.

DEER MOUNTAIN HATCHERY STOCKS: A king salmon stock which originated at the Unuk River has been started at the Deer Mountain Hatchery. In 1979 about 18,150 smolts were released from the hatchery. About 100 of these returned as jacks in 1979, indicating that they had survived the transition to salt water. Two additional year-classes of Unuk River kings are being reared for release at Deer Mountain. It is expected that those fish will provide future brood stocks for the hatchery which is intended to rehabilitate the Cripple Creek, Unuk kings. Eggs may be available from kings returning to the Little Port Walter Hatchery in 1980. Small egg takes of 60,000 annually are planned for Cripple Creek to continue research on imprinting. More eggs will be taken there only if Little Port Walter has no eggs to spare.

Coho salmon returns in Ketchikan Creek migrate to hatchery holding areas from which they were released as smolts. No alternative actions are needed to maintain this stock.

Steelhead eggs will be taken at Ward Creek in 1980, as a beginning of an environmental damage mitigation project for which the Department received money in 1979.

BEAVER FALLS BROOD STOCKS: Sufficient chums are returning to the hatchery to fulfill brood stock requirements at present, provided there is no increase in the commercial harvest of these stocks. The 1980 goal of 5 million eggs will require 2,000 females, which is the entire projected return. If hatchery objectives are increased, additional brood stock must be located.

HIDDEN FALLS BROOD STOCKS: Kadashan chums are thought to move through Icy Straits, and then down Chatham Straits. Most of the chum catch is incidental to pink seine fisheries in Tenakee Inlet. The chum escapement to Kadashan will probably be better next year than in the recent past. There could be as many as 20,000 chums in the stream. If this is true, FRED will be able to take 9 to 10 million chum eggs in 1980, according to the management plan developed for that stock.

Clear River chums migrate through Kelp Bay at the southern entrance to Peril Strait. These fish have been cleared for use at the Hidden Falls Hatchery. However, the Kelp Bay seine fishery is efficient in harvesting fish that might otherwise be used to develop brood stock at Hidden Falls.

CRYSTAL LAKE HATCHERY STOCKS: King and coho salmon returning to the Crystal Lake Hatchery generally move down the west side of Baranof Island, enter Sumner Strait, and move into Wrangell Narrows from the north and south end. Sixty to eighty percent of the harvest is taken by trollers, the rest by gill netters and sport fishermen. Harvest-to-escapement ratios on returns to the hatchery seem to be about 60 to 40 for cohos and 80 to 20 for kings. Management strategies adequately provide for hatchery brood stock. Some surplus fish can be taken by net gear and trollers at the mouth of Blind Slough. In the future, fish may be released from Ohmer Creek, where there is a better terminal harvest area. Biologists are investigating this.

The first post-disinfection cohos will return to Duncan Salt Chuck in 1980. An escapement of about 4,000 cohos is expected, which will fill the hatchery's coho brood stock requirements. Isolation facilities and screening by pathologists will allow king salmon and steelhead trout, returning to the hatchery from pre-disinfection releases, to be used as brood stock. The goal for king salmon is 1 million eggs. Eggs from all returning steelhead will be taken. Fish culturists plan to take 300,000 chum eggs from fish returning to Crystal Creek.

SNETTISHAM HATCHERY BROOD STOCKS: Adults returning to the Snettisham Hatchery will probably move through Icy Straits, around the north end of Admiralty Island, and past Juneau. The first chum returns to the

hatchery are expected in 1980 and probably will number several hundred fish. Eggs will be taken from these, but the bulk of the hatchery's eggs must come from wild chum stocks. Summer chums are scarce in the Snettisham area. The search for a chum donor stock that could support a 10 million egg take has ranged from Port Frederick to Frederick Sound. Wild stocks examined will be prioritized by early winter. Recommendations will be made at that time to shelter desired wild donor stocks from commercial fishing. FRED plans to take 200,000 coho eggs from wild Speel Lake stock, and 200,000 king eggs from wild King Salmon River stock.

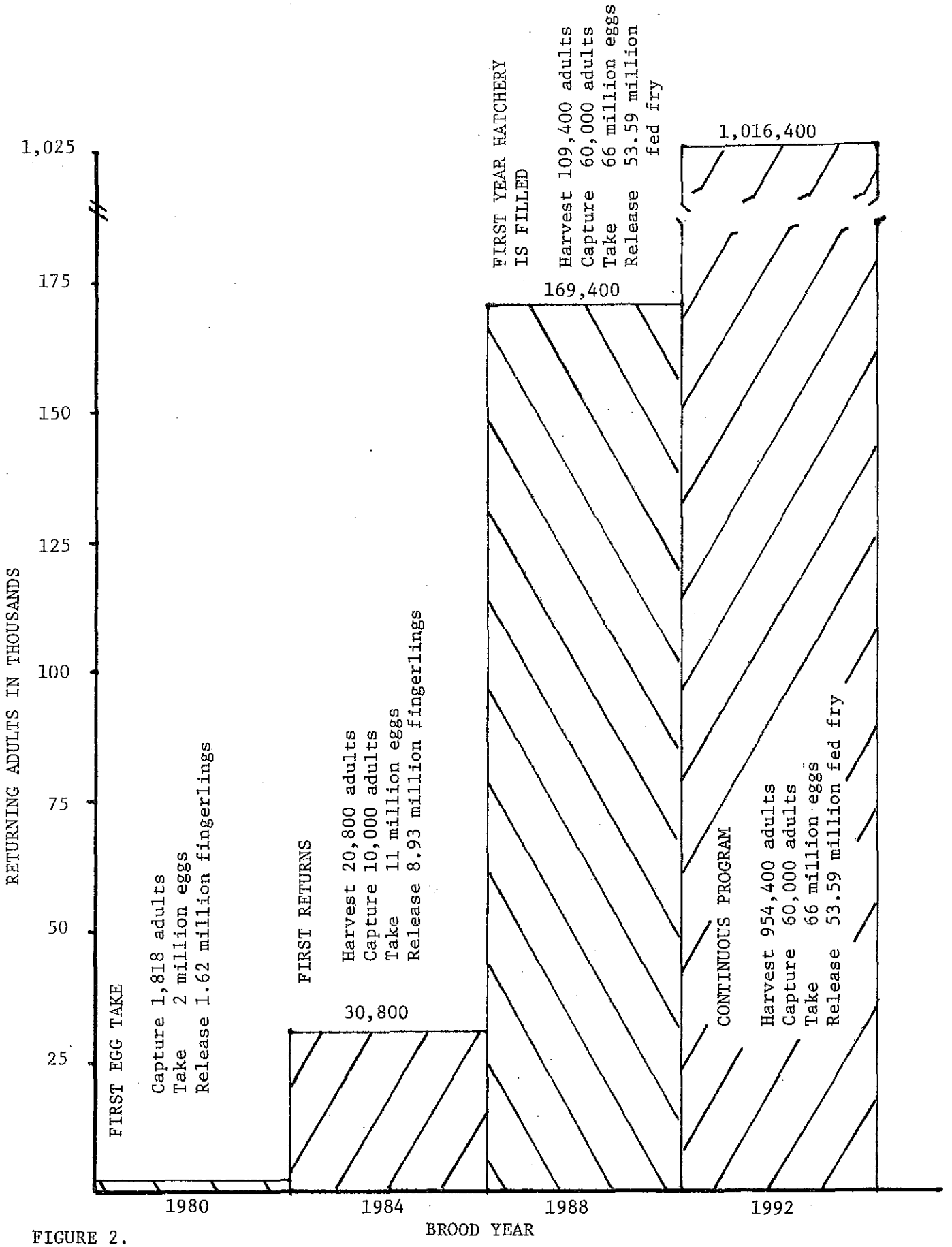
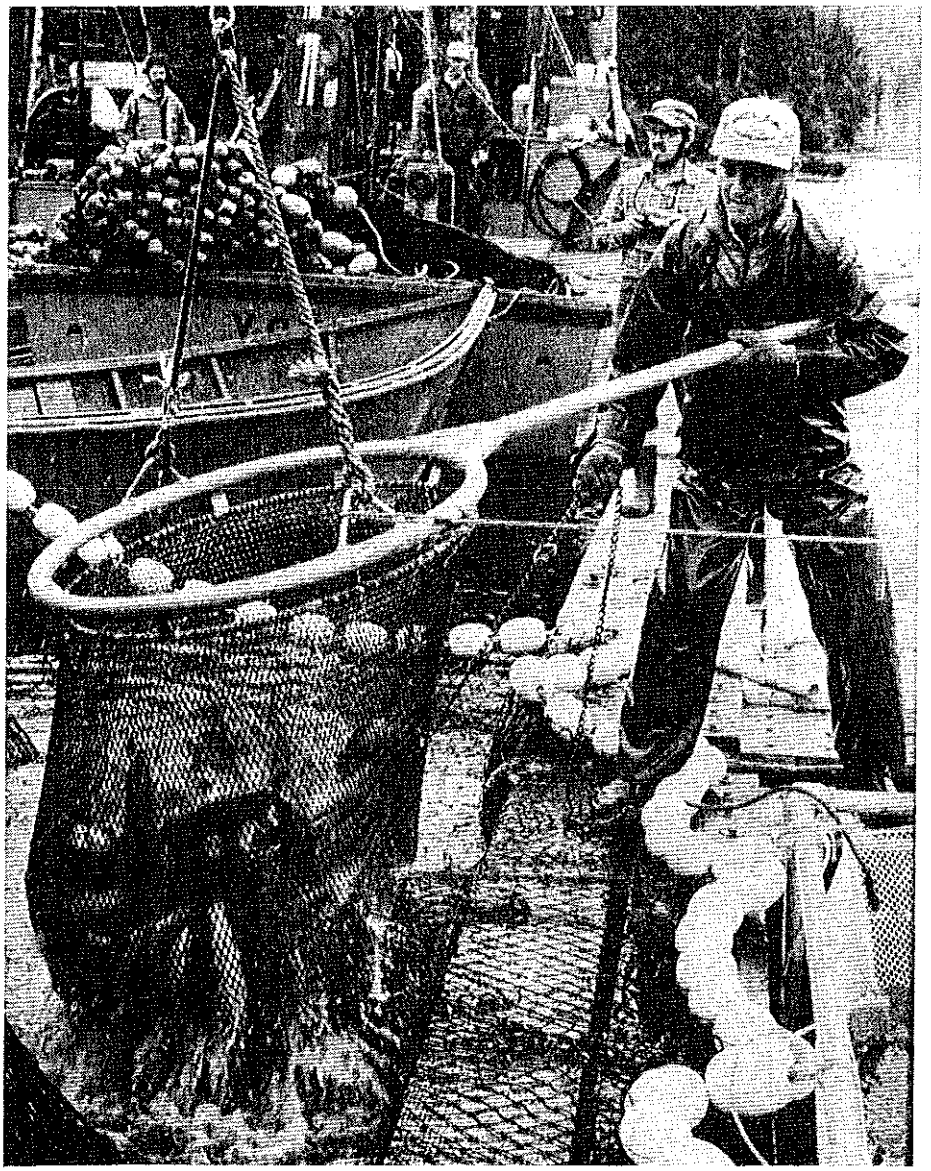


FIGURE 2.

Brood stock development program of a hypothetical 66-million-egg chum salmon hatchery showing the production of adults and the lag time between the first egg take and the first year the hatchery is filled. The number of adult returns assumes an ocean survival of 2%.

FISHERIES
AND THE
UTILIZATION OF HATCHERIES



An unidentified fisherman brails pink salmon from his seine during an emergency commercial opening in Tutka Bay Lagoon. (ADF&G photo)

FISHERIES AND THE UTILIZATION OF HATCHERIES

Background on fisheries

Commercial fishermen, on the average, recorded bonanza years in 1978 and 1979. The graphs in Figures 3,4,5,6 and 7 illustrate that chinook, pink, and sockeye catches exceeded the 30-year consecutive high mean annual harvest in 1979. This average is used as an indicator of the potential sustained yield of a fishery. In the last two years, the statewide fishery on most salmon species has been above or near its potential.

Does this mean that hatcheries are no longer needed in Alaska?

The answer is no, and for many reasons. Although the statewide harvests are above or near historical levels, some individual stocks remain depressed. Further, a look at the graphs of salmon harvests from 1960 through 1979 reveals a trend of natural fluctuation. In the last 19 years, the overall trend has been a "boom and bust" cycle, with the actual harvest of salmon far below the potential as expressed in the 30-year consecutive high mean. This "boom and bust" cycle has far-reaching economic importance. Table 21 shows that the fishing industry is second only to petroleum in economic importance among Alaska's natural resources.

Table 22 illustrates the distribution of commercial salmon fishing effort in Alaska as represented by the number of limited entry permits issued for each type of fishing gear. More than 15,000 permits were in effect in 1979.

Data show that most sport fishing effort is expended in the Southcentral region of the state. Nearly 70% of all sport fishing is in fresh water. According to data supplied by the Division of Sport Fisheries, 206,185 anglers fished 1,285,063 man-days and harvested 2,358,603 fish during 1978. More than 70% of the total effort was expended in Southcentral. The Cook Inlet area accounted for 59% of the total; the Kenai Peninsula accounted for 41% of the total, and the Kenai River alone accounted for 13% of the state's total sport fishing effort. The distribution of sport fishing effort is clearly unbalanced, and becoming more so as the Cook Inlet area grows in population. Rehabilitation and enhancement are important now, and will be more so in the future, to provide fish for sportsmen, especially in the Southcentral population center. The 1978 sport harvest of salmon was 394,000 in Southcentral, 118,000 in Southeastern, and 13,000 in the Arctic-Yukon-Kuskokwim. A detailed breakdown of sport fishing effort, catches, and other pertinent information may be found in A Special Report to the Board of Fisheries 1979, Alaska Department of Fish and Game, Sport Fish Division.

Applications of public hatcheries

The following outline lists some of the primary applications of public fish hatcheries. Hatcheries can:

A. Decrease natural fluctuation in fish production by providing a dependable resource base for commercial, sport, and subsistence fisheries.

1. Provide supplemental production for increased user needs.
2. Provide a stable economic base for the fishing industry.
3. Increase egg to fry survival 800 percent over natural incubation.
4. Restore depleted stocks with fish and eyed egg plants in natal streams and lakes.
5. Provide a production base to develop new stocks in previously barren waters.
6. Provide trout and other species to sport fisheries that occur at locations where natural reproduction is limited by the environment.
7. Bolster individual stocks that cannot be managed separately from existing mixed stock fisheries.

B. Serve as a base for research.

1. Provide a controlled environment for the study of fish diseases and genetics.
2. Aid in the study of life histories of fishes.
3. Develop techniques as an aid to private hatchery operators.

C. Through release of marked and tagged fish, add to the knowledge of the saltwater cycle of salmonids.

1. Determine saltwater mortality rates.
2. Determine environmental carrying capacities, and provide opportunities for increased production.
3. Improve management techniques and procedures through a study of the migration patterns of marked hatchery fish.

D. Provide a positive approach to salmon production and management in Alaska.

1. Utilize ocean grazing areas.
2. Exercise this State's rights to those ocean salmon rearing areas.

The full potential of hatcheries

In many areas, manipulation of harvest by regulation alone is inefficient, especially if one stream in the system dominates in the number of fish it contributes. Many small streams that were once good producers of salmon are now depressed because their fish are harvested incidentally to larger, more commercially important stocks. The smaller streams can be supplementally stocked from nearby hatcheries to realize their full potential along with the dominant stream. If the production potential

of artificial salmon and trout facilities is to be realized, some of their production must be blended in with natural production in the areas surrounding these facilities.

The effect and importance of hatcheries would then extend outward from the facility in concentric circles. A hatchery is capable of production during the early life stages of salmon that far exceeds the facility's capacity as the fish grow. For example, a coho hatchery can carry many more salmon to the fry stage than to the smolt stage. This fact offers the opportunity for production to be channeled into the natural environment. Identification of these rehabilitation and enhancement opportunities is essential. Figure 8 presents an illustration of possible pathways for salmon enhancement.

FIGURE 3

CHINOOK SALMON CATCHES FROM 1960 ON COMPARED TO THE 30-YEAR CONSECUTIVE HIGH MEAN ANNUAL HARVEST

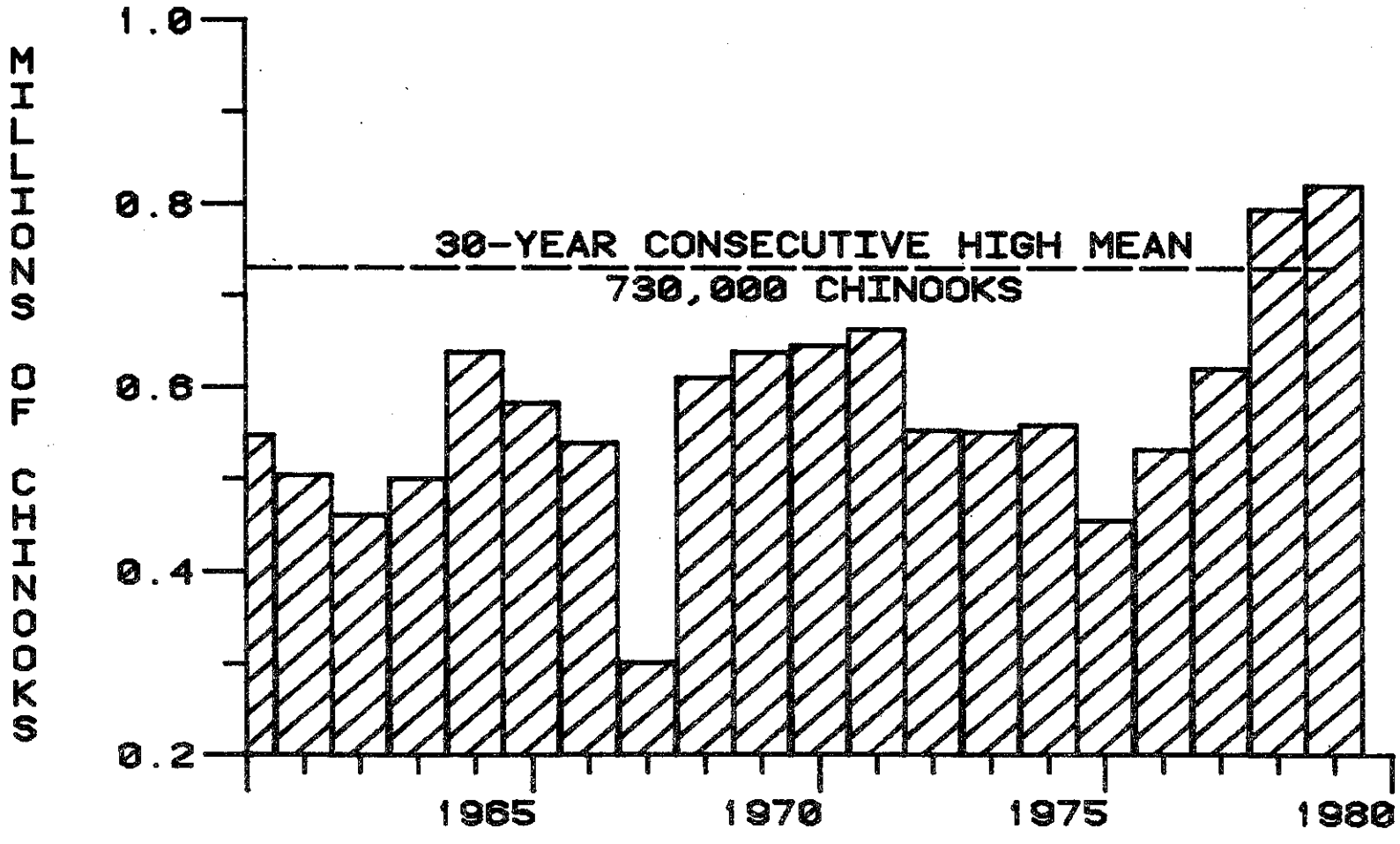


FIGURE 4

COHO SALMON CATCHES FROM 1960 ON COMPARED
TO THE 30-YEAR CONSECUTIVE HIGH MEAN ANNUAL HARVEST

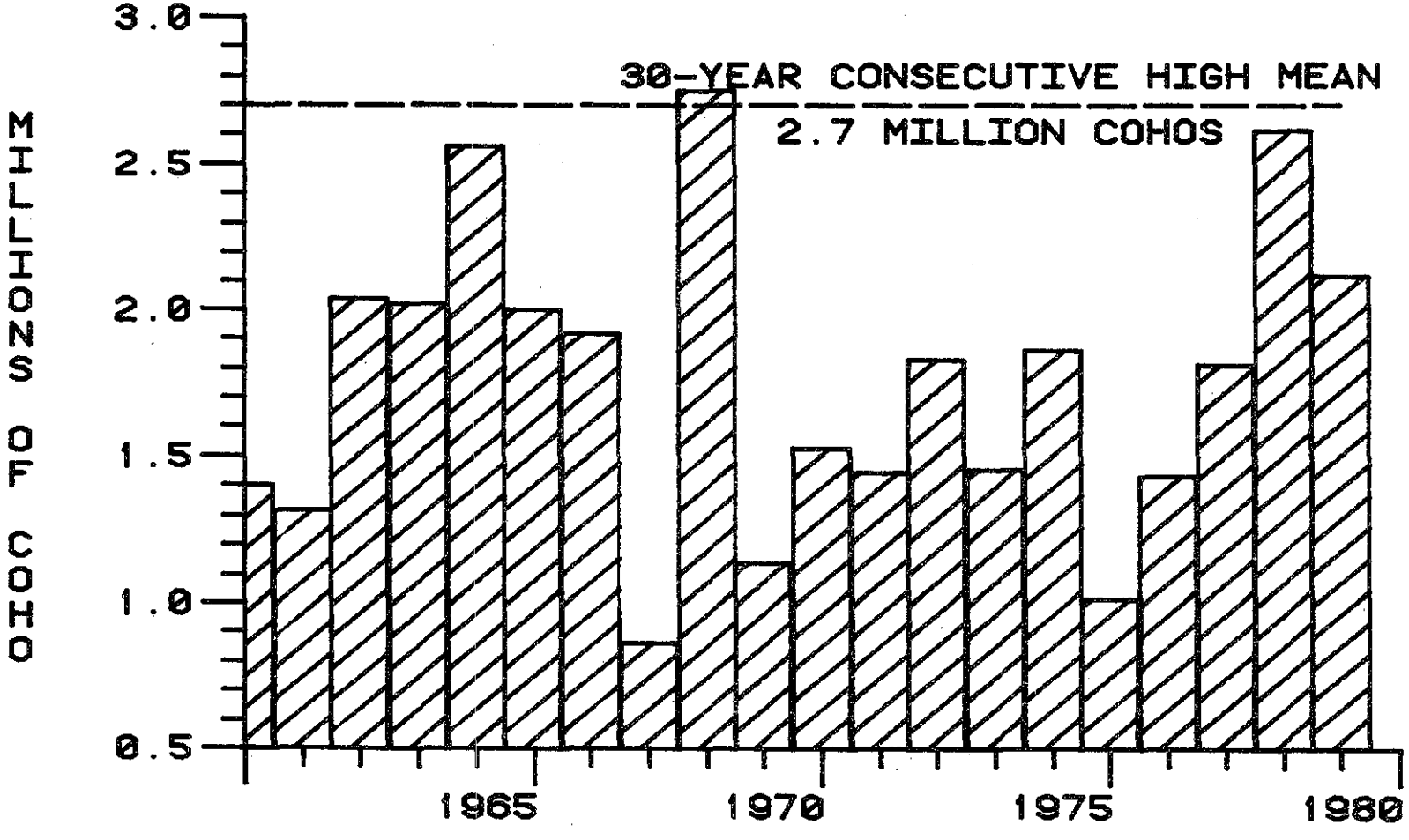


FIGURE 5

SOCKEYE SALMON CATCHES FROM 1960 ON COMPARED TO THE 30-YEAR CONSECUTIVE HIGH MEAN ANNUAL HARVEST

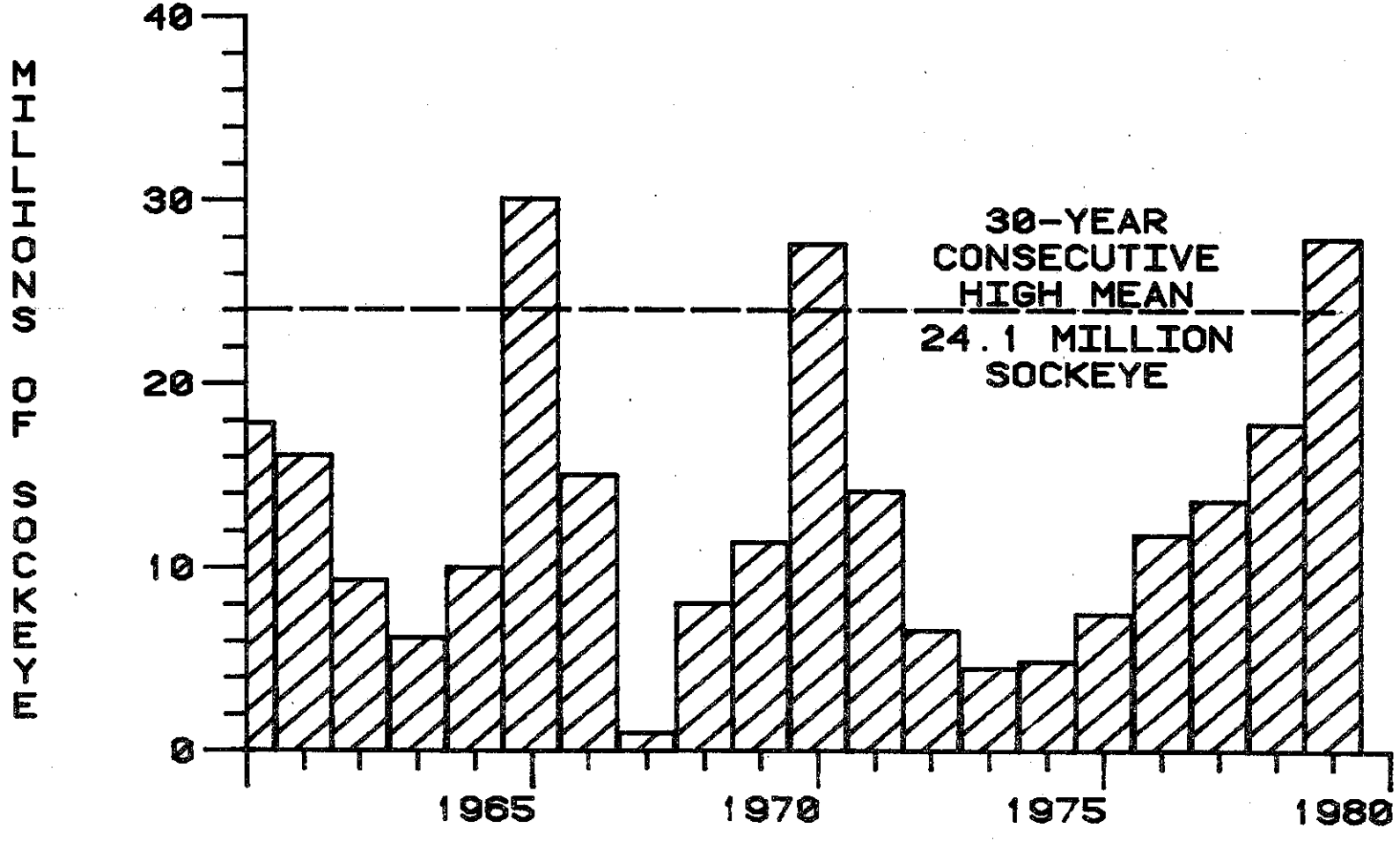


FIGURE 6

PINK SALMON CATCHES FROM 1960 ON COMPARED
TO THE 30-YEAR CONSECUTIVE HIGH MEAN ANNUAL HARVEST

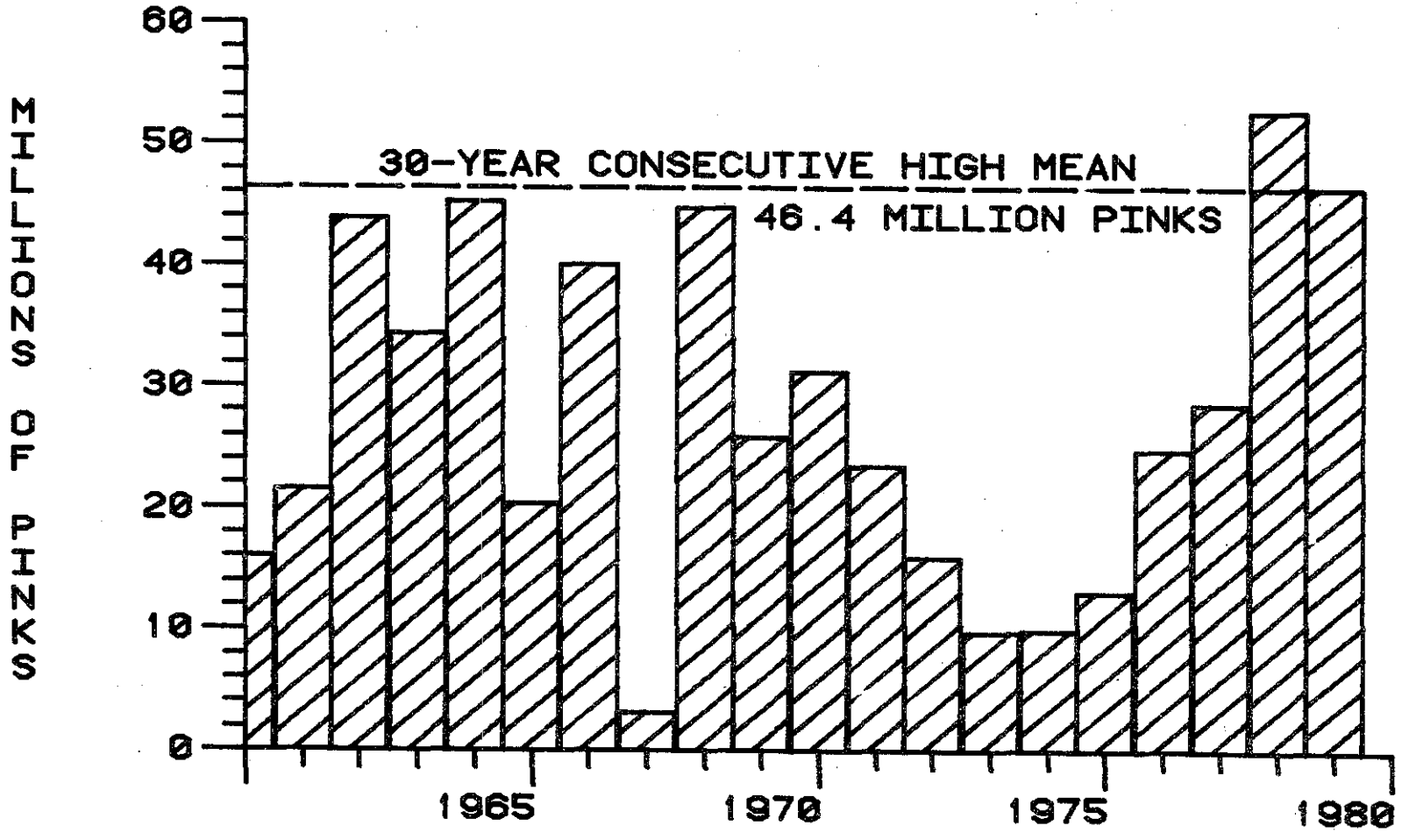


FIGURE 7

CHUM SALMON CATCHES FROM 1960 ON COMPARED
TO THE 30-YEAR CONSECUTIVE HIGH MEAN ANNUAL HARVEST

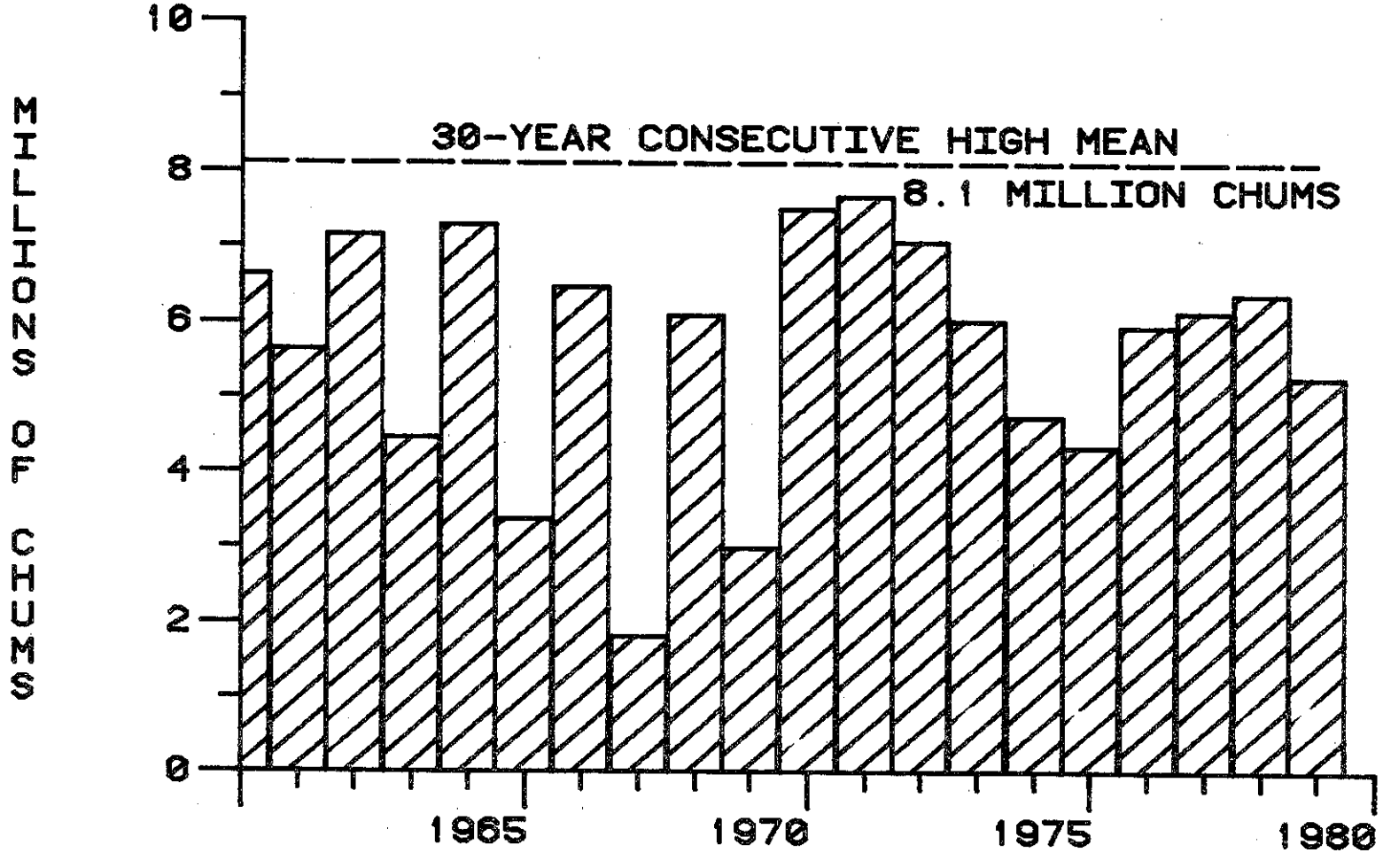


TABLE 21

ALASKAN RESOURCE PRODUCT VALUES
1960-1976**
(millions of dollars)

Year	Oil & Gas	Other Minerals	Fish	Timber	Agriculture	Total Products
1960	1.3	20.6	96.7	47.3	5.5	171.4
1961	17.8	17.0	128.7	48.0	5.7	217.7
1962	31.7	22.5	131.9	52.3	5.8	244.2
1963	33.8	32.5	109.0	54.1	5.5	234.9
1964	35.3	30.6	140.9	61.0	5.7	273.5
1965	35.9	47.6	166.6	57.5	5.5	313.1
1966	50.4	35.9	197.3	71.2	5.6	360.4
1967	95.5	41.6	126.7	80.6	5.5	349.9
1968	191.1	30.6	191.7	89.2	5.4	508.0
1969	227.1	30.5	144.2	101.0	4.6	507.4
1970	279.1	59.2	213.9	93.7	5.5	651.4
1971	286.5	46.3	198.7	103.5	5.5	640.5
1972	253.9	32.1	203.0	113.7	5.7	608.4
1973	281.4	47.4	307.6	174.3	6.9	817.6
1974	369.3	69.1	254.4	213.7	8.1	914.6
1975	313.0	67.7	293.2	193.8 P/	9.2	876.9 P/
1976	383.4	241.8*	484.4	208.2 P/	8.8	1,351.6 P/

P/ Preliminary data, subject to revision.

* Other minerals includes the unusually high impact of pipeline road construction aggregate use in 1976.

** Data are available only to 1976. Oil and gas values have far exceeded fish values since that year.

Source data are from "Alaska Statistical Review" and "The Alaskan Economy," Alaska Division of Economic Enterprise.

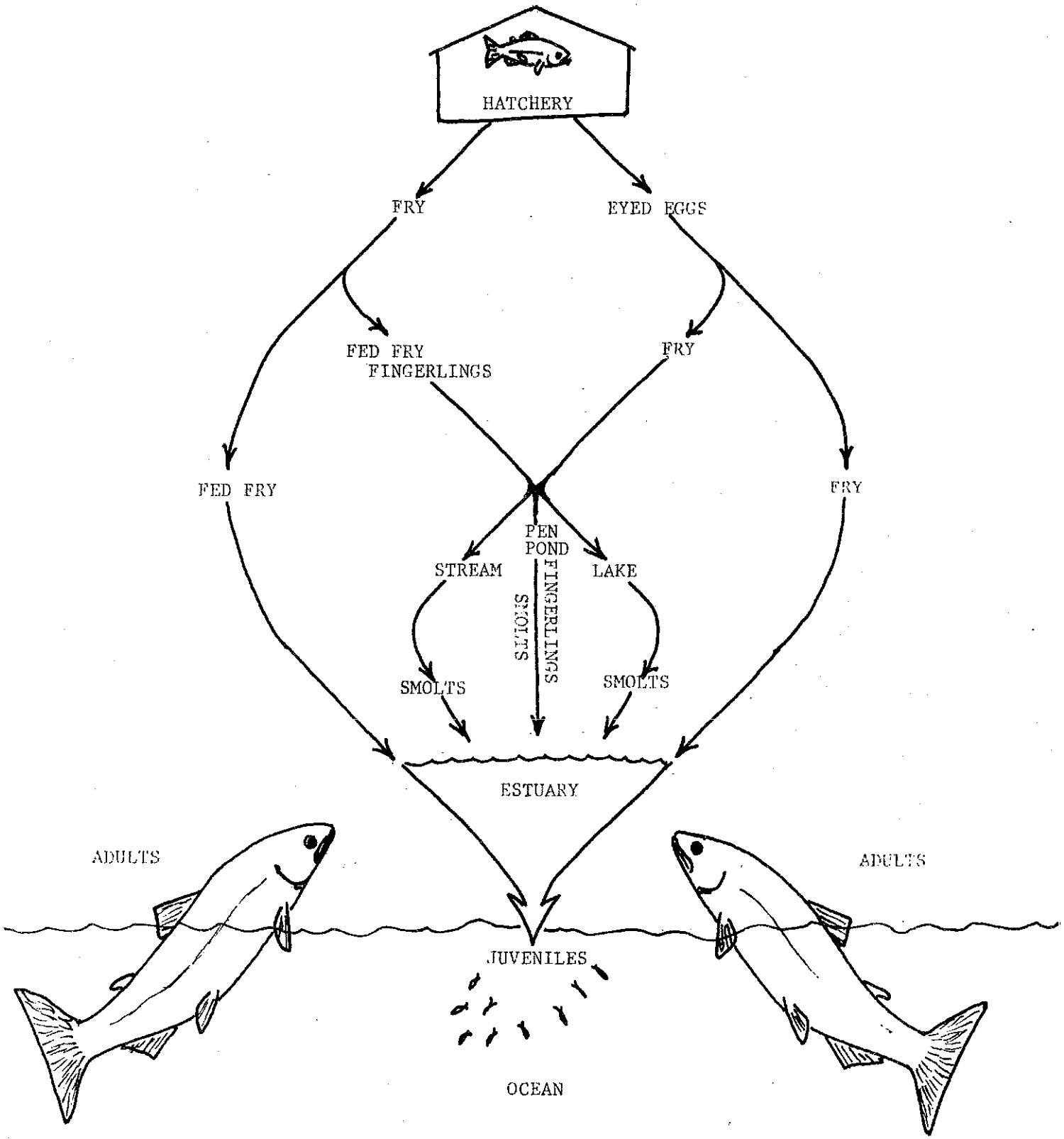
TABLE 22

COMMERCIAL FISHING INTENSITY IN SECTIONS OF ALASKA DURING 1979 AS REPRESENTED BY THE NUMBER OF SALMON LIMITED ENTRY PERMITS ISSUED FOR VARIOUS FISHING GEAR

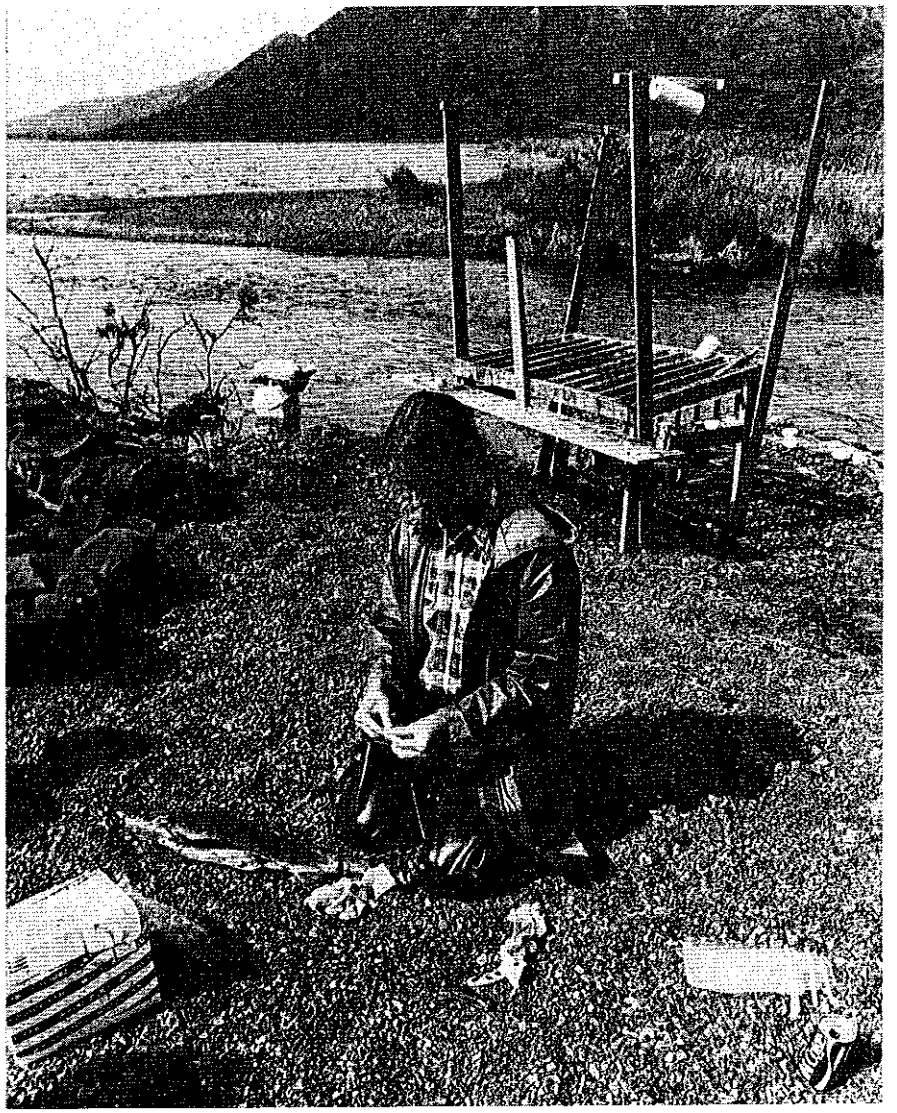
AREA	GEAR	PERMITS
Southeastern	purse seine	421
	drift gill net	492
	beach seine	2
	hand troll	5,557
	power troll	979
Prince William Sound	purse seine	269
	beach seine	1
	drift gill net	549
	set net	29
Cook Inlet	purse seine	83
	drift gill net	599
	set net	749
Chignik	purse seine	101
Peninsula-Aleutians	purse seine	123
	drift gill net	161
	set net	114
Bristol Bay	drift gill net	1,799
	set net	935
Yakutat	set net	167
Kuskokwim	gill net	814
Upper Yukon	gill net	70
	fish wheel	165
Lower Yukon	gill net	706
Kotzebue	gill net	203
Norton Sound	gill net	200
Kodiak	purse seine	387
	beach seine	34
	set net	186
	STATE TOTAL:	15,895

FIGURE 8.

OPPORTUNITIES FOR SALMON REHABILITATION AND ENHANCEMENT
THROUGH THE COMBINED USE OF HATCHERY AND NATURAL ENVIRONMENTS.



HISTORY AND ORGANIZATION OF FRED



Fish Culturist Lynne Bonner takes tissue samples from a sockeye at Francis Creek in the Bristol Bay region during an egg take there in 1979. (ADF&G photo by Mark Kissel)

HISTORY AND ORGANIZATION OF FRED

The FRED Division was created by the State Legislature in 1971 when it became apparent that management techniques alone could not rehabilitate Alaska's fisheries. In theory, managers could restore salmon production by restricting or relaxing harvest regulations to assure that enough salmon reached their spawning areas to reproduce. However, when environmental factors were unfavorable, management could not prevent low production. Then commercial, subsistence, and sport fishermen became dissatisfied.

Persons concerned with the State's fisheries began developing a concept of "total fisheries management." This included the interrelated elements of stock allocation, stock enhancement, stock rehabilitation, habitat improvement, and research.

From this view, and armed with recent advances in fish husbandry technology, the FRED Division was created and charged with these statuatory obligations as found in Title 16.05.092:

(1) develop and continually maintain a comprehensive, coordinated State plan for the orderly present and long-range rehabilitation, enhancement and development of all aspects of the State's fisheries for the perpetual use, benefit and enjoyment of all citizens and revise and update this plan annually;

(2) encourage the investment by private enterprise in the technological development and economic utilization of the fisheries resources;

(3) Through rehabilitation, enhancement and development programs do all things necessary to insure perpetual and increasing production and use of the food resources of Alaska waters and continental shelf areas;

(4) make a comprehensive annual report to the legislature containing detailed information regarding its accomplishments under this section and proposals of plans and activities for the next fiscal year, not later than 20 days after the convening of each regular session.

Since then, the concept of "total fisheries management" was understood to include 1) stock allocation, 2) non-regulating stock rehabilitation, 3) stock development, 4) fishery enhancement, 5) fishery development, and 6) research. Through the concept of total fishery management, the FRED Division became a full participant in the Department's fisheries program. The FRED Division is involved in four of these six categories. They are defined as follows:

Non-Regulatory Stock Rehabilitation: Utilization of hatcheries and the natural environment to increase the numbers of fish in depressed stocks until the stocks can maintain their numbers through natural reproduction.

Fishery Enhancement: Utilization of hatcheries and the natural environment to supplement variable natural production.

Stock Development: Utilization of hatcheries and improvements or alterations in natural habitats to create new stocks of fish in naturally barren streams and lakes.

Research: Systematic inquiry into the development and efficiency of aquaculture systems and methods; suitability and manipulation of habitat for salmon production; presence, frequency and prevention of disease; and determination of genetic and environmentally controlled characteristics of salmon and trout.

In creating FRED, the Legislature and Administration directed it to test new concepts in salmon husbandry, such as substrate incubation and sequential estuarine and saltwater rearing. Cooperative agreements were reached with the National Marine Fisheries Service to test concepts at its Auke Bay laboratory.

Razor clam and whitefish development programs were transferred to FRED from the Division of Commercial Fisheries. FRED terminated the razor clam project when the state entered the National Shellfish Sanitation Program. Admission to that program was one of the major objectives of the project. The whitefish project was transferred back to Commercial Fisheries for stock management.

In 1974, Alaskan voters approved a bond issue for construction of small hatcheries throughout the State. After the election, Governor Jay Hammond established the Governor's Fisheries Council, which led the initial planning of total fisheries management in Alaska. The Department drafted the "Alaska Salmon Fisheries Plan," a preliminary document. It has served as the basis for subsequent hatchery bond issues in 1976 and 1978.

Private nonprofit hatcheries

The 1974 Alaska Legislature provided for the ownership of salmon hatcheries by Private Nonprofit Corporations (PNP), subject to a permit approved by the Commissioner of the Alaska Department of Fish and Game (ADF&G). Since that time, eleven Private Nonprofit Salmon Hatchery Permits have been approved. Six of the permitted hatcheries are in operation, and three of them have already had adult salmon return to the hatchery. Four facilities are expecting returns in 1980. Lists of PNP hatcheries and proposed hatcheries are presented in Tables 23 and 24.

The establishment and growth of these hatcheries is contributing to the State's effort to rehabilitate depleted and depressed salmon fisheries. The hatcheries are planned and must be managed to allow reasonable segregation of returning hatchery-reared salmon from natural stocks. The guideline is this: natural stocks must not be affected adversely by the hatchery operations.

The 1974 legislation was amended in 1977 to establish a regional salmon enhancement planning program. ADF&G responded by dividing the State into planning regions. Commercial fishermen and other interested persons in each region were encouraged to form Private Nonprofit Corporations and request recognition from the Commissioner as qualified Regional Associations. Five Regional Associations have been recognized to date, and other groups are seeking recognition. The PNP program has been coordinated by FRED since 1977.

Once recognized, the Regional Associations are eligible for financial support from the State. Most of the financial backing for these Regional Associations, however, comes from a voluntary three percent assessment on all salmon commercially harvested within that region by limited entry permit holders. Some of these Regional Associations have built PNP hatcheries. Other hatcheries have been built by smaller, "mom and pop" PNP Corporations.

Each Regional Association can elect three members to serve on the Regional Planning Team with three members of the ADF&G. This team prepares a comprehensive salmon plan for the region, and provides a strategic review of PNP Hatchery Applications and operational plans. All plans and reviews by the Regional Planning Teams are subject to approval by the Commissioner of the ADF&G.

Over the last four years, the Department has developed policies and procedures regarding PNP and Regional Planning programs. These have undergone extensive public review and should be available in final form in late 1979. These policies will be used to evaluate applications for PNP Salmon Hatchery Permits and to determine compliance once permits are issued.

As may be expected, this developing program is not without controversy. Several issues face the hatchery and planning program in the immediate future. The financing of the Regional Associations was originally provided by a mandatory three percent assessment upon a vote of the limited entry permit holders of the region. The law providing this, however, was ruled unconstitutional by the Superior Court. Funds from the assessment are required for collateral on loans from the State loan program. It is unknown at this time whether the voluntary assessment will provide adequate collateral for the construction and operation of hatcheries by these groups.

Also, the mechanism of cost recovery through hatchery harvest and sale of returning adults is essentially experimental at this time. No one knows whether it will be sufficient to repay the interest and principle on hatchery construction loans, as well as cover operational costs.

As this program evolves, common goals are being established, which allow all concerned to work cooperatively. This is not necessarily an easy task, but it is one worth the effort.

Organization

Faced with expanding responsibilities, FRED has had to analyze its ability to handle them. Successful application of modern fish husbandry technology in Alaska depends upon a thorough knowledge of the ecosystem. Information on food chains, genetics, fish diseases, life histories, and survival criteria are prerequisites for a successful program.

Of equal importance is an organization capable of welding together the disciplines of biology, engineering, genetics, pathology, fish culture, maintenance, planning, and project management in a manner permitting maximum coordination and quality control among them.

This did not always exist. From 1971 until July 1, 1977, two hatchery development and operational units existed within the department -- FRED and the Hatchery Services Section. The Hatchery Services Section, and an Engineering Section, each reported independently to the Commissioner of Fish and Game.

The Legislature and Administration recognized these inconsistences and pressed for a resolution. A task force of senior people worked with management consultants to reorganize the FRED Division, including within it the old hatchery section and the engineering section. FRED converted to a matrix organization (Fig. 9). A policy and procedures manual was drafted for the Division and the PNP hatchery program.

There are three organizational branches of the Division:

1. Operations (Program and Project Management)
2. Technology and Development (Research and Development, Quality Control)
3. Administration (Legal, Clerical, Budgeting, Accounting)

These three branches interact through five principal program and project management systems. These five systems are:

1. Strategic Management Planning
2. Operational Planning
3. Technical Quality Control
4. Project and Facility Fiscal and Legal Control
5. Project Management

The Strategic Planning System remains essentially underdeveloped for two major reasons: the Department has not adopted a fisheries plan to replace the "Alaska Salmon Fisheries Plan," and the Regional Planning Teams have only recently been sufficiently funded to develop such a plan. Goals and objectives are derived presently from the "Alaska Salmon Fisheries Plan." Consequently, the Operational Planning System is primarily aimed at achieving objectives of that plan in the public sector with public funds.

The Technical Quality Control System is in place. Performance indicators have been established for hatcheries. Data are now accumulating for comparison between actual and planned production by species, facility, and culture method. Tables 5 through 14 are examples of performance indicators applied to hatchery production of salmon. Personnel from the Operations and Technology branches are seeking to perfect a computer program to handle these data and analyses.

The Project and Facility Fiscal and Legal Control System operates in the following sequence:

1. Setting objectives
2. Technical review and approval
3. Estimating costs by phase and time
4. Budgeting and approval of budget
5. Allocation and expenditure by project and activity
6. Accounting by project and activity

The Administrative branch uses computers for sorting and analyzing project or facility and activity budget codes. Administration is responsible for the accuracy and legality of all allocations and expenditures. This system also provides Operations managers with data for determining cost-effectiveness by facility and production phase.

The Project Management System is contained within the Operations branch. Personnel there are responsible for achieving objectives on time and within budget. Operations personnel manage people in all other branches, integrate disciplinary output, and control expenditures for achievement of objectives. By drawing upon all analyses (fiscal and technical) managers provide the control for all activities at project, regional, and division levels.

A rehabilitation and enhancement project must be based on a fully, rationally developed program. For example, hatchery sites must be selected with more than water availability in mind. Harvest strategies, production costs and benefits, and dozens of other considerations must be taken into account. The elements of fishery rehabilitation and enhancement are multi-dimensional and interrelated. FRED is developing a "team concept" for problem solving and project development. These teams are staffed from different disciplines and from different branches of the Division. A permanent Facility Development Team is functioning. Other teams are created and disbanded according to particular needs and problems.

Plans and assumptions

In addition, FRED develops and updates strategies and plans for rehabilitation and enhancement projects. Plans are based on assumptions, which are either biological, economic, social, or aesthetic. In Alaska, fish are needed as an industry base, as a major form of recreation, as an important food item for humans and animals, and as organisms adding pleasantness to our surroundings.

Some of the assumptions underlying the plans of the Department and Division are as follows:

1. The Alaskan public desires an active and progressive fisheries program.
2. Many salmon stocks have diminished below threshold levels of productivity and cannot rebound because of the effects of predation and other causes of mortality.
3. Limited entry regulations alone cannot result in the restoration of the annual salmon catch to historical levels.
4. Present day management techniques will not by themselves restore the annual salmon catch to historical levels.
5. Widely varying environmental conditions greatly influence freshwater and saltwater survival of salmon.
6. World-wide climate changes may result in decreased survival of salmon.
7. Many presently underutilized salmon stocks could be overutilized before an adequate fisheries program for maintenance and restoration of those stocks is begun.
8. The Department is developing and refining the expertise to successfully manipulate fish stocks through culture techniques and habitat alteration.
9. Salmonid rehabilitation and enhancement activities can stabilize an otherwise fluctuating resource. This tends also to stabilize commercial and sport fish related industries.
10. Many waters of the State that have been naturally unavailable to anadromous fish can be altered to efficiently provide new salmonid production.

Personnel capabilities

Within FRED, technological personnel and program and project managers interact continually, creating a balanced program. The FRED Division presently relies on the expertise of 159 employees operating within a FY 80 budget of nearly 8 million dollars. The staff is comprised of the following disciplines and specialties:

CLASSIFICATIONS	FY 80 Number of Employees
Biologists/Biometricians	36
Fish Culturists	53
Fish Technicians	3
Maintenance	10
Pathologist/Geneticist/Microbiologist	7
Engineering/Drafting	13
Typist/Secretary/Accounting	22 1/3
Management/Administration	14
	158 1/3

A list of FRED's senior staff is presented in Table 25. These people are located in Juneau, Anchorage, and Soldotna.

TABLE 23
1979 OPERATIONAL PNP HATCHERIES

CORPORATE NAME	HATCHERY LOCATION	EGG CAPACITY IN MILLIONS
Southern Southeast Regional Aquaculture Association	Ketchikan	2.3 coho 26.0 chum
Alaska Aquaculture Foundation Inc.	Wrangell	5.0 pink & chum
Sheldon Jackson College Aquaculture Program	Sitka	15.0 pink & chum
Douglas Island Pink and Chum Corp. (Kowee Creek)	Juneau	5.0 pink 1.0 chum
Prince William Sound Aquaculture Association	Port San Juan (P.W.S.)	55.0 pink & chum
NERKA Inc.	Perry Island (P.W.S.)	3.0 pink & chum
Meyers Chuck Aquaculture Association	Meyers Chuck	1.0 pink
Kake Nonprofit Fishery Development Corporation	Kake	3.0 pink & chum

TABLE 24
PROPOSED PNP HATCHERIES
(permits issued)

CORPORATE NAME	HATCHERY LOCATION	EGG CAPACITY IN MILLIONS
Tlingit & Haida Central Council	Baranof Island	1.0 pink 1.0 chum
Douglas Island Pink and Chum Corp. (Sheep Creek)	Juneau	5.0 pink & chum
Fish Fry, Inc. (Salmon Creek)	Juneau	4.5 chum .5 coho

FIGURE 9
FRED DIVISION MATRIX ORGANIZATION

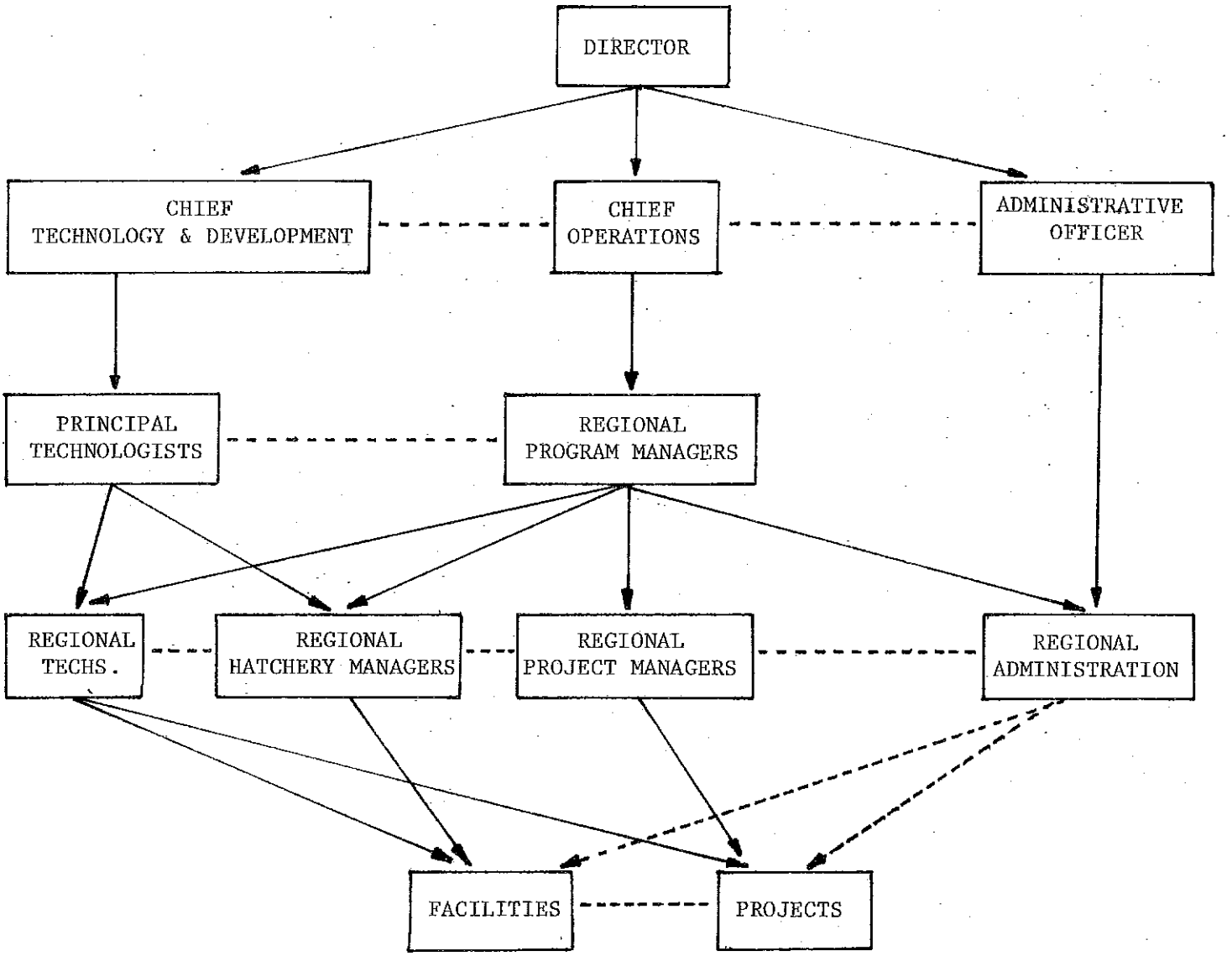
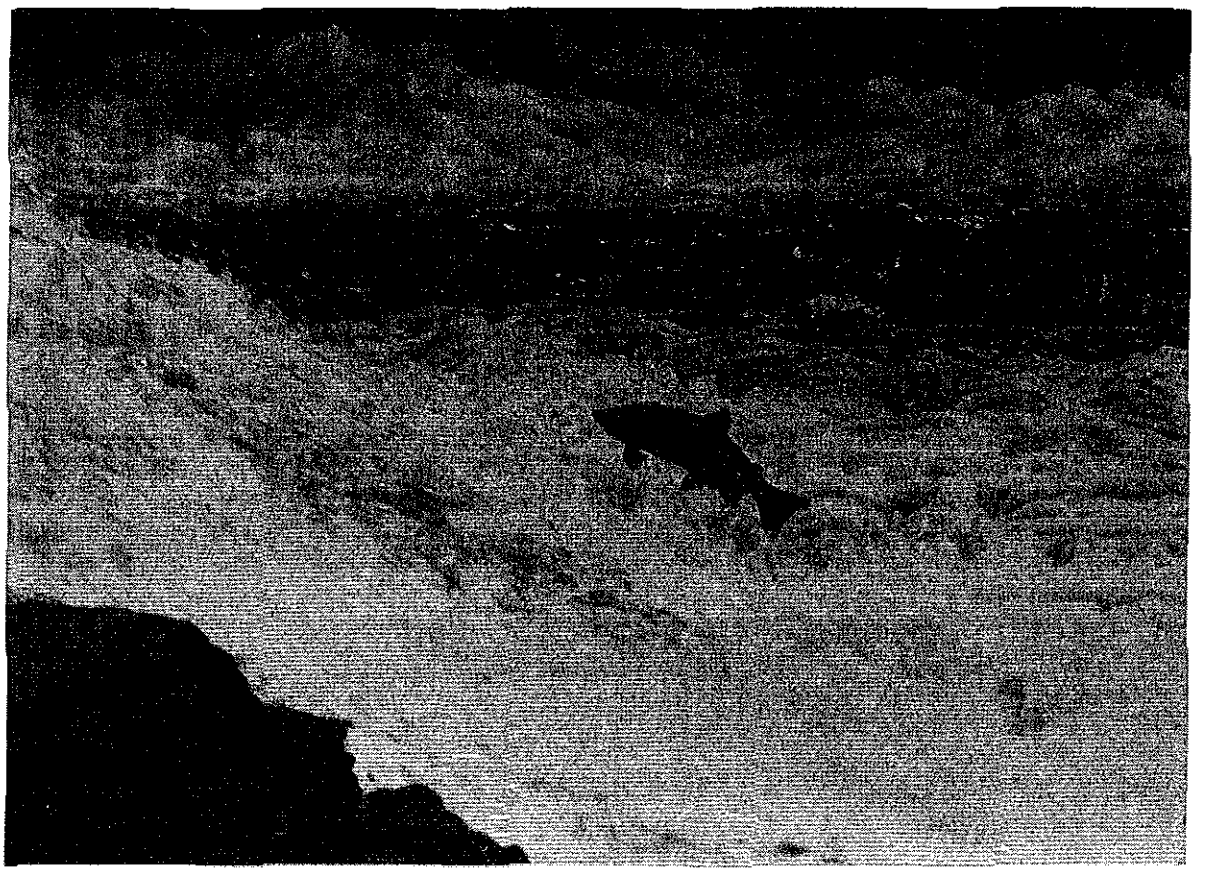


TABLE 25

FRED Division Senior Staff, 1979

Name	Title
Robert S. Roys	Director
John McMullen	Chief of Operations
Dr. Bob Burkett	Chief of Technology and Development
Beverly Reaume	Administrative Officer
Stan Moberly	Southeastern Regional Program Manager
Dave Daisy	Central Regional Program Manager
Bob Lium	Hatchery Developer
Lowell Barrick	Department Engineer
Dr. Ken Leon	Principal Biologist
Dr. Bernie Kepshire	Principal Fish Culturist
Dr. Roger Grischkowsky	Principal Pathologist
Dr. Bob Davis	Principal Geneticist
Dr. Jeff Koenings	Principal Limnologist

PROGRAM BENEFITS



A mature salmon leaps at the falls on Apollo Creek, Unga Island.
(ADF&G photo by Mark Kissel)

PROGRAM BENEFITS

In the eight years since FRED was created, the Department changed its relatively simple management policy of manipulating harvests of natural stocks into a broader policy including the most advanced fish management techniques. That the Alaskan public desires such a program was demonstrated by the 1976 and 1978 bond proposals for major hatchery development. Both proposals were approved at the polls.

Part of that public support may stem from a realization that dollars invested in salmon rehabilitation create new and renewable dollars, generating a multitude of public benefits not limited to sport and commercial fishermen. Increased earnings from salmon fishing will allow Alaskan fishermen to branch out into other areas, such as bottomfish and herring fishing. Selectively enhancing early and late-run salmon stocks will extend the fishing and processing period. This will have a significant effect on local communities by extending employment. Such enhancement and development can also create new saltwater sport fisheries for king and coho salmon. Cultural traditions of coastal communities, which are largely based upon salmon, will be maintained.

Dollars invested in rainbow trout, grayling, and sheefish enhancement will strengthen the tourist industry and provide increased angling opportunities for Alaskan sportsmen.

The goal of the FRED Division is to produce adult fish. Therefore, even though short-term (one year) objectives are generally expressed as numbers of eggs to be taken, the underlying objectives are the adult salmon that result from each egg take. Most species of Alaskan salmon enter the fisheries as multi-age adults. This means that fish from eggs spawned in one year may return to spawn in two or more different years. The reasons are that some fish from the same brood stock and brood year may rear in freshwater or remain at sea for different lengths of time before maturing.

The numbers and value of adult salmon returning to hatcheries in Alaska will increase annually until full production is reached at each hatchery. Rather than estimate numbers and value of fish for a given year, it is easier and as accurate to estimate the number and value of adults which will be produced by one year's egg take. Numbers of green eggs can be transformed into adults by applying FRED's standard assumptions for survival of eggs and fish.

FRED's objective is to take 205 million eggs during Fiscal Year 1981 (Table 16). By applying standard survival factors for eggs and fish, these eggs should yield 5,394,687 adults (Table 26). The commercial value of these adults, exclusive of rainbow and steelhead trout, is based upon 1978 regional sale prices paid to dominant gear types landing each species. The projected value of returns from the FY 81 egg take is about $16.6 million. This is a minimal figure because many of the kings and cohos that are destined for sport creels will have a much higher

TABLE 26. Estimates of commercial values of adult salmon that will be available in Alaskan waters as a direct result of eggs incubated by FRED in Fiscal Year 1981.

Facility	Species	Projected Return Number of Adults	Commercial Value in 1978 Dollars
SOUTHEAST ALASKA			
Beaver Falls	Chums	77,000	$594,825
Crystal Lake	Chums	4,620	29,845
Crystal Lake	Kings	18,600	431,297
Crystal Lake	Cohos	93,000	997,425
Crystal Lake	Steelhead	1,488	---
Deer Mountain	Kings	37,200	857,758
Deer Mountain	Cohos	15,500	120,125
Deer Mountain	Steelhead	279	---
Hidden Falls	Chums	154,000	871,794
Hidden Falls	Cohos	7,700	92,516
Klawock	Chums	154,000	1,189,650
Klawock	Cohos	29,260	226,765
Snettisham	Chums	61,600	581,196
Snettisham	Cohos	920	8,843
Snettisham	Kings	3,080	71,770
SOUTHEASTERN TOTALS		658,247 1/	$6,073,809
CENTRAL-WESTERN-NORTHERN ALASKA			
Anchorage Area	Kings	37,200	$1,165,104
Anchorage Area	Rainbows	1,344,000	---
Anchorage Area	Cohos	161,200	1,021,363
Big Lake	Sockeyes	136,000	1,220,736
Big Lake	Cohos	61,600	390,297
Cannery Creek	Pinks	77,000	113,190
Cannery Creek	Chums	77,000	280,280
Clear	Chums	8,008	20,997
Clear	Kings	575	10,090
Clear	Cohos	770	3,043
East Creek	Sockeyes	127,500	583,312
Karluk	Sockeyes	212,500	1,285,200
Kasilof	Sockeyes	170,000	1,525,950
Kitoi	Pinks	415,800	582,120
Kitoi	Chums	30,800	108,601
Kitoi	Kings	1,380	24,207
Main Bay	Pinks	15,400	22,638
Main Bay	Chums	15,400	56,056
Russell Creek	Chums	294,140	1,503,644
Tutka	Pinks	231,000	277,200
Tutka	Chums	77,000	336,798
CENTRAL REGION TOTALS		3,494,273 1/	$10,530,776
GRAND TOTALS		4,152,520	$16,604,585

1/ Excludes rainbow and steelhead trout.

value than that assigned to commercially caught fish. Also, rainbow and steelhead trout have not been assigned a monetary value. Projected values are thought to be minimal estimates for yet another reason. Pink salmon returns, for instance, are estimated using an ocean survival projection of 2%. However, returns of Tutka pinks that were reared for a short time before release indicate that their actual survival at sea may be at least 100% greater than estimated.

The $16.6 million value projected for adult salmon returns from eggs to be incubated in 1980 can be used to compare FRED's present potential for salmon production to its full capability when all presently funded hatcheries reach full production. To accomplish this, estimates of adult returns and the values of those returns were extracted from Table 26 and placed in Table 27 along with projections for full production of presently funded hatcheries. The design capacity of funded FRED hatcheries is 635.4 million eggs (Table 19). The 4.1 million salmon which result from the 1980 egg take is less than half of the 9 million fish expected to return to fully producing hatcheries.

Associated raw fish values at the 1978 regional price levels will increase from $16.6 million to $52.5 million annually, assuming no price changes.

TABLE 27. Projected numbers and values of adult salmon returning to FRED hatcheries at 1980 and full capacity levels of production.

Region	1980 Production Level		Full Capacity	
	Return	Value	Return	Value
Southeastern	658,247	$6,073,809	3,507,723	$27,447,043
Central/Western	3,494,273	$10,530,776	5,520,023	$25,015,995
TOTAL	4,152,520	$16,604,585	9,027,746	$52,463,038

We expect that improved technology will increase the survival of hatchery fish. This consideration, along with the inclusion of the estimated sport values of trout, grayling, and sheefish, will probably push the annual value of hatchery production over $75 million annually.

Most returning salmon are available to the fishery users. A small percentage, however, must be taken for brood stock or allowed to spawn naturally. These fish are just as valuable as the fish that are caught. Therefore, the value of the fish that escape the fisheries (escapement) is included in Tables 26 and 27.

Analysis of benefits and costs

Benefit/cost analyses are often used in hatchery planning. The result of the analysis is a ratio that compares the dollar value of the benefits created by a hatchery with the dollar value of the costs. The ratio is expressed as one number; a hatchery with a benefit/cost of 2.4, for example, produces $2.40 in benefits for every $1.00 in cost. Table 19 lists benefit/cost ratios for FRED hatcheries.

Benefits are not created evenly over the life of a hatchery. As described in the section on brood stock development, it takes years to bring a hatchery to full production. Likewise, the capital cost of building a hatchery occurs before any benefits can be created. In a new hatchery, therefore, it is probable that costs outweigh benefits. As the hatchery reaches full production, however, the balance shifts, and benefits overtake costs. Because of this uneven distribution of benefits and costs, FRED calculates benefit/cost ratios on the productive life of a hatchery. Hatcheries are assumed to have a 20-year life at full production.

The ratio, of course, depends upon the planner's definitions of "benefit" and "cost." FRED uses a moderate measure of benefits: the price paid to fishermen for the expected number of fish returning to the fishery, minus required brood stock, based on present values. A higher ratio could be calculated, for example, by including in the definition the gross income to fish wholesalers or the hatchery-related income to fishing communities. Costs are defined as the capital investment plus the present worth of all operational costs over the life of the facility. Operational costs are the estimated costs of running the hatchery at full capacity plus 20% for administration and evaluation.

A benefit/cost ratio would look like this:

$$\frac{\text{Present worth of 20-year harvest value}}{\text{Capital cost + present worth of 20-year operational cost}}$$

A benefit/cost analysis is based on many assumptions. The assumptions that most radically affect the ratio are operational cost and marine survival of hatchery fish. If a planner assumes a $50,000 annual operational cost that in reality leaps to $100,000, the actual benefit/cost ratio would be far less than the planner's estimate. If a planner assumes a 2% marine survival and the hatchery actually achieves a 4% survival, the actual benefit/cost ratio would be double the planner's estimate.

BUDGET

Hatchery personnel carry chests of salmon eggs across the flats to the Tutka Bay Lagoon Hatchery. (ADF&G photo by Jeff Stafford)

BUDGET

FY 80 operational budget

The FRED program comprises projects which utilize hatcheries as one strategy for producing fish. Project leaders serve as representatives to the Alaska public at the local level. They also provide technical support to Regional Planning Teams. In addition to developing fishery rehabilitation and enhancement projects in response to department goals and objectives, the project leaders evaluate all aspects of each hatchery's production and performance.

Project objectives are listed as numbers of adult fish which are made available to the fisheries. Therefore, the rates of return, timing, and distribution of returns in the fisheries indicate the quality of fish released by the hatchery and the performance of each stock. Marked fish recoveries provide information to managers who must deal with the difficult problems of mixed stock fisheries.

Staffing and budgeting within FRED is directed toward expanding the program to take advantage of as many rehabilitation and enhancement opportunities as possible. This is to be accomplished primarily through hatcheries. The FY 80 operational budget is itemized in Table 28 to further describe the organization and extent of the FRED program.

Funding and production

A frequently asked question concerns the relationship between hatchery funding and the period of time required to bring production potential on line. Table 29 details funding sources and levels for the FRED Division since its inception. Also included in that table is the account of production capabilities which have resulted or will result from these construction funds. The lag time between funding and operational start-up is graphed in Figure 10. The lag time is necessitated, of course, by design and construction phases. Although time is of essence in a salmon rehabilitation program, the important point here is that FRED's capacity to produce fish has grown rapidly in recent years and can contribute fish to depressed, developing, and expanding fisheries. The question before FRED now is one of operational funding for the future. Division personnel are attempting to develop recommendations regarding possibilities for operational cost recovery.

TABLE 28

PROJECT AND FACILITY BUDGETS

Listed below are the FRED Division project budgets by component for FY 80 and the budget request for FY 81.

PROJECT	FY 80 BUDGET	FY 81 BUDGET
ADMINISTRATION COMPONENT		
Director's Office	270.5	282.1
Clerical Statewide	416.0	455.7
Private Nonprofit	79.5	87.2
Hatchery Developer	58.5	69.6
sub total	824.5	894.6
TECHNOLOGY AND DEVELOPMENT COMPONENT		
Chief Technology and Development	83.1	86.9
Principal Fish Culturist	55.5	54.0
Genetics	110.1	112.2
Principal Biologist	55.5	55.0
Pathology	269.2	265.6
Engineering	333.1	427.8
Lake Fertilization/Limnology	184.1	131.0
sub total	1090.6	1132.5
OPERATIONS COMPONENT		
Chief of Operations	59.5	66.7
SOUTHEAST REGION		
Regional Management	141.3	187.3
Regional Biology	120.5	130.6
Regional Hatchery Management	85.4	95.1
Southern Southeast Project Control and Evaluation	126.3	128.3
Western Southeast Project Control and Evaluation	69.7	75.3
Northern Southeast Project Control and Evaluation	85.1	99.5
Regional Maintenance	59.5	80.9
Beaver Falls Hatchery	38.5	45.1
Deer Mountain Hatchery	122.4	162.4
Klawock Hatchery	302.4	324.1
Starrigavan Hatchery	57.1	---
Hidden Falls Hatchery	334.2	402.4
Snettisham Hatchery	176.2	345.9
Crystal Lake Hatchery	313.8	370.1
Little Port Walter Hatchery	33.3	29.1
Coastwide Evaluation	61.0	53.6
Irish Creek	---	24.0
sub total	2126.7	2553.7
CENTRAL/WESTWARD/AYK REGION		
Regional Management	218.9	196.3
Regional Biology	98.6	100.9
Regional Hatchery Management	147.6	151.4
Regional Maintenance	93.0	132.3
Biometrics	80.4	87.9
Alaska Peninsula Project Control and Evaluation	66.4	83.7

(CONTINUED)

	FY 80 BUDGET	FY 81 BUDGET
Bristol Bay Project Control and Evaluation	106.6	147.6
Kodiak Project Control and Evaluation	136.5	186.4
Prince William Sound Project Control and Evaluation	97.0	145.6
Upper Cook Inlet Project Control and Evaluation	88.4	153.3
Lower Cook Inlet Project Control and Evaluation	106.7	176.4
Central Cook Inlet Project Control and Evaluation	89.6	163.4
Cannery Creek Hatchery	162.0	263.7
Big Lake Hatchery	198.6	228.5
Fort Richardson Hatchery	364.5	375.4
Ship Creek Hatchery	245.2	233.7
Tutka Hatchery	252.2	318.2
Halibut Cove Hatchery	26.0	22.6
Kitoi Hatchery	150.7	216.2
Karluk Hatchery	157.3	157.5
Russell Creek Hatchery	399.6	449.3
East Creek Hatchery	151.9	268.4
Kasilof Hatchery	236.5	288.0
Clear Hatchery	40.0	203.6
Trail Lakes Hatchery	30.7	71.7
Whittier Coho Rehabilitation	7.3	12.0
Wood River Char Control	32.4	36.5
Paint River	35.9	---
Hobo Creek	7.9	---
Knik Coho Rehabilitation	34.0	---
Fire Lake Hatchery	15.0	10.0
Main Bay Hatchery	---	71.6
sub total	3770.84	4952.1
TOTALS		
ADMINISTRATION	824.5	894.6
TECHNOLOGY AND DEVELOPMENT	1090.6	1132.5
OPERATIONS	6063.6	7572.5
GRAND TOTAL	7978.7	9599.6

TABLE 29

FRED DIVISION OPERATIONAL AND CAPITAL PROJECT BUDGETS AND THEIR EFFECT ON INCREASES IN HATCHERY PRODUCTION CAPABILITIES.

Fiscal Year	Operational Budget (thousands)	Capital Funding (thousands) Yearly	Capital Funding (thousands) Cumulative	Cumulative Operational Egg Capacity (millions)
1971	---	---	---	8.6
1972	200.0	70.0	70.0	14.4
1973	690.8	349.8	419.8	14.4
1974	1,013.4	1,645.1	2,064.0	
1974	(Bond)	6,099.4	8,164.3	14.4
1975	1,407.9	1,763.5	9,927.8	14.4
1976	2,264.1	249.0	10,176.8	
1976	(Bond)	28,040.0	38,216.8	19.8
1977	4,503.1	2,575.1	40,791.9	94.8
1978	6,975.1	1,688.8	42,480.7	
1978	(Bond)	25,743.0	68,223.7	96.8
1979	9,134.0	1,712.5	69,736.2	111.8
1980	7,978.8	131.0	69,867.2	316.8
1981	---	---	---	433.4*
1982	---	---	---	625.4*
1983	---	---	---	635.4*

* Projections based on present development schedules.

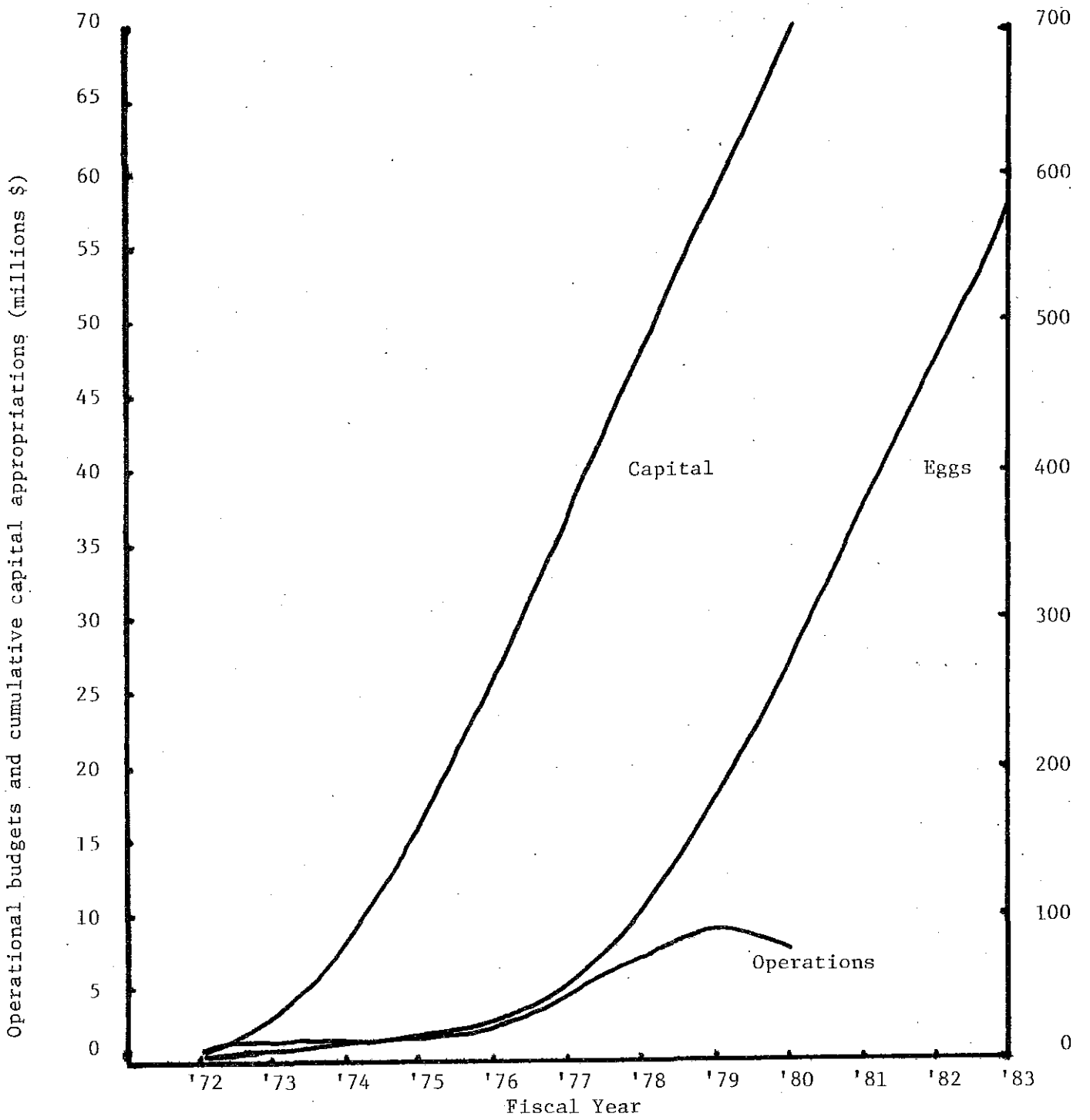


Figure 10 FRED Division cumulative capital appropriations, operational egg incubation capacity and operational budget summary. Data are smoothed for visual interpretation.

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